INDIAN BIRD LIFE

BY THE SAME AUTHOR

ANIMALS OF NO IMPORTANCE
THE INDIAN CROW: HIS BOOK
BOMBAY DUCKS
BIRDS OF THE PLAINS
INDIAN BIRDS
JUNGLE FOLK
GLIMPSES OF INDIAN BIRDS
BIRDS OF THE INDIAN HILLS
IN THE DAYS OF THE COMPANY
BIRDS OF AN INDIAN VILLAGE
BYGONE DAYS IN INDIA
HIMALAYAN AND KASHMIRI BIRDS
A HANDBOOK TO THE PRE-MUTINY RECORDS OF THE GOVERNMENT OF THE UNITED PROVINCES
THE COMMON BIRDS OF INDIA—THE SPORTSMAN'S BIRDS
WILD BEASTS OF AN INDIAN VILLAGE

In collaboration with Frank Finn
THE MAKING OF SPECIES

In collaboration with R. G. Wright
THE DUCKS OF INDIA

INDIAN BIRD LIFE

OR THE STRUGGLE FOR EXISTENCE OF BIRDS IN INDIA

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PREFACE

THIS book is of necessity largely a compilation of the observations of field naturalists. I tender my thanks to the many observers of whose observations I have made use; but for such observations the book would never have been written. A list of those to whom I am beholden is given at the end of the volume. Many of them are military officers. In no case have I stated the rank of such, because, in the case of men on active service, this is ever changing. The same officer may record observations as a subaltern, a captain, a major and so on; thus, were the military rank given at the time of every observation, it might well be that the same officer would appear as a colonel in an early, and as a captain in the later, part of the book!

As regards the nomenclature adopted in this work, the earlier observers, when dealing with Indian birds, have used that of Jerdon; I have adopted that of Blanford and Oates in the Bird volumes of the *Fauna of British India*. This is the nomenclature with which I, in common with the great majority of field naturalists in India, am familiar. These volumes are now out of print and a new edition is appearing piecemeal. In this very drastic alterations in the

nomenclature are being made. For the benefit of the younger generation of naturalists I have inserted in this book a table showing, in the case of Indian birds cited, against the names here given, those under which they have appeared or are likely to appear in the new edition of the *Fauna*. Any reader in doubt as to any bird mentioned is referred to this table. No trinomials have been used in this book, species and not local races being dealt with.

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INTRODUCTION

DARWIN, in his *Origin of Species*, devotes very little space to the consideration of the struggle for existence. This is perhaps not surprising. At first sight all that seems necessary to establish the truth of the theory of Natural Selection is the demonstration of the fact that a struggle for existence inevitably follows from the high rate at which all organisms tend to increase. This Darwin does in the following words (*Origin of Species*, sixth edition, p. 50): "Every being, which during its natural lifetime produces several eggs or seeds, must suffer destruction during some period of its life, and during some season or occasional year, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support the product." Darwin candidly admitted our ignorance of the nature of the struggle for existence. On page 50 he writes: "We know not exactly what the checks are in even a single instance."

He attempts no detailed inquiry into the question. He contents himself with noticing very briefly a few of the checks to the increase of the animal and plant populations. "The amount of food," he writes on page 53, "for each species, of course, gives the extreme

limit to which each can increase; but very frequently it is not the obtaining food, but the serving as prey to other animals which determines the average numbers of a species." He further says (p. 54): "Climate plays an important part in determining the average numbers of a species, and the periodical seasons of extreme cold or drought seem to be the most effective of all checks."

Darwin cites epidemics as a third check. He also points out that the struggle almost inevitably will be most severe between the individuals of the same species, for they frequent the same districts, require the same food and are exposed to the same dangers.

Darwin recognizes that eggs and very young animals seem generally to suffer most, but qualifies this with the remark: "this is not invariably the case" (p. 53).

As Darwin's knowledge increased he found it necessary to modify his early opinion of the importance of natural selection as a factor in organic evolution. The following pregnant passage appears on page 68 of the sixth edition of the *Origin of Species*: "It may be well here to remark that with all beings there must be much fortuitous destruction, which can have little or no influence on the course of natural selection. For instance, a vast number of eggs or seeds are annually devoured, and these could be modified through natural selection only if they varied in some manner which protected them from their enemies. Yet many of these eggs or seeds would perhaps, if not destroyed, have yielded individuals better adapted to

their conditions of life than any of those which happened to survive. So again, a vast number of mature animals and plants, whether or not they be the best adapted to their conditions, must be annually destroyed by accidental causes, which would not be in the least degree mitigated by certain changes of structure or constitution which would in other ways be beneficial to the species. But let the destruction of adults be ever so heavy, if the number which can exist in any district be not wholly kept down by such causes—or again let the destruction of eggs or seeds be so great that only a hundredth or a thousandth part are developed—yet of those which do survive, the best adapted individuals, supposing that there is any variability in a favourable direction, will tend to propagate their kind in larger numbers than the less well adapted. If the numbers be wholly kept down by the causes just indicated, as will often be the case, natural selection will be powerless in certain beneficial directions; but this is no valid objection to its efficiency at other times and in other ways; for we are far from having any reason to suppose that many species ever undergo modification and improvement at the same time in the same area."

Thus it is evident, as Darwin admits, that, if all destruction of life be what he describes as fortuitous, there is no room for the operation of natural selection.

From this it follows that, until we have full knowledge of the nature of the struggle for existence of any particular species, we are not in a position to say

whether or not natural selection has been a factor in the evolution of that particular species.

Unfortunately, Darwin's followers, instead of seizing upon the above admission and developing it, seem to have ignored it. In consequence many biologists have assumed that natural selection is the sole cause of organic evolution, and, as a result, the attractive, but probably unsound hypotheses of protective coloration, mimicry and warning coloration have been elaborated and have commanded wide acceptance.

The writings of many appear to be based on the assumption that only the individuals less well adapted to their environment perish in the struggle for existence, and that this struggle takes place only or mainly among adults.

No one seems to have studied in detail the struggle for existence among any class of organisms in any one country, in consequence, after all these years, we are still not in a position to say of any species how far its evolution has been effected by natural selection.

There are, it is true, in the various scientific publications many notes dealing with the enemies of animals and plants, but no one seems to have concentrated upon any country or class of organisms and collected the notes that apply, with a view to endeavour to ascertain the nature of the struggle in the case of that particular class of organism.

In the present work an attempt is made to visualize some aspects for the struggle for existence of birds in India.

Introduction

The picture I have attempted to draw is very imperfect, it is constructed from the observations of others and those of myself made during a residence of some five-and-twenty years in India. Imperfect though the picture is, it will, I hope, be useful in attracting the attention of field naturalists to the subject and thereby leading them to make and record observations with a view to complete the picture.

ABBREVIATIONS USED IN THE TEXT

A.M.=The Avicultural Magazine.

B. =The Journal of the Bombay Natural History Society.

B.N.=Bird Notes: The Journal of the Foreign Bird Club.

J.=Jerdon's *Birds of India.* 3 vols.

H. and M.=Hume and Marshall's *Game Birds of India, Burma and Ceylon.* 3 vols.

N. and E.=Hume's *Nests and Eggs of Indian Birds.* 3 vols.

Roman figures denote the number of the volume, and Arabic figures the number of the page on which the reference occurs.

INDIAN BIRD LIFE

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I. THE DESTRUCTION OF EGGS AND NESTLINGS

THERE cannot be an ornithologist in India who has failed to notice the enormous destruction of eggs and nestlings that takes place in that country.

That the various scientific journals do not contain many references to this is the result of the fact that most of the observers are collectors of eggs, who take most of the clutches they find instead of waiting to see what becomes of the eggs if left undisturbed. Moreover, as egg-collectors want fresh eggs, they search for nests early in the breeding season. In consequence, most of the records of destruction relate to nests which a disappointed collector has found empty on his first visit, or which were rifled while he was waiting until the full clutch should be laid.

Despite this there are numbers of records that testify to the amount of destruction of eggs and nestlings that takes place in India.

E. A. Butler, writing of the ashy wren-warbler (*Prinia socialis*), says (*N. and E.*, I. 294): "In addition to the above I found numerous other nests all through

August, many of which were destroyed by something or other—what I do not know. In fact, it has always been a puzzle to me what it is that takes the eggs of these small birds; three out of four nests, when visited a second time, are either empty, gone altogether or pulled down; and how the birds ever manage to hatch off a brood at all with so many enemies I do not know."

E. H. Aitken writes of the Indian wren-warbler (*Prinia inornata*), (*N. and E.*, I. 303): "I think they have only one brood in the year, but, like *Orthotomus* and *Prinia*, one or two nests are generally deserted or destroyed by some accident before they succeed in rearing a brood."

J. Davidson remarks on the very large percentage of the eggs of the rain quail (*Coturnix coromandelica*) that are destroyed by vermin. He very frequently found their eggs broken and scattered about.

R. M. Betham writes (*B.*, XI. 316): "I wonder if other egg-collectors have had the same experience as myself. I have found at least half a dozen or more of the nests of the white-spotted fantail (*Rhipidura pectoralis*), but, as yet, have not obtained the eggs. The same fatality appears to hang over many other species. In the case of the iora (*Ægithina tiphia*) I have found a dozen nests or more and have only got three eggs; they appear to construct many nests and then desert."

Later Betham (*B.*, XII. 775) records that his experience is that the eggs of the white-browed fantail flycatcher (*Rhipidura albifrontata*) are invariably destroyed by some unknown marauder, and of the

white-spotted fantail he writes: "The number of nests that are destroyed prior to completion is simply marvellous." He attributes this to the fussy habits of the birds, which betray the fact that they are engaged in nest-building. Still later the same observer writes: "From observations extending over many years, I have, more or less, formed the opinion that the majority of birds rarely rear the same number of young as eggs laid."

J. P. Cook writes (*B.*, XXII. 264): "*Pycnonotus xanthorrhous* (Anderson's bulbul) suffered terribly from some nest-robber, human or otherwise, nor was it the only bird; *D. sannio* was also in a bad plight. Over and over again eggs were removed from nests I had been watching."

J. M. D. Mackenzie, writing of the nests of laughing thrushes at Maymyo, says (*B.*, XXV. 745): "Of fifteen nests of *G. monileger* and *pectoralis* found, eleven contained cuckoo's eggs, and rats or crows took the eggs out of two of the rest. This means a loss of thirteen out of fifteen nests, 14 per cent being all that have any chance of successfully hatching out, unless the cuckoo's eggs were addled; in all but one nest two or more of the cuckoo's eggs would have to be addled. It seems extraordinary that the laughing thrushes do not rapidly disappear under such adverse conditions."

C. B. Ticehurst writes (*B.*, XXVIII. 798): "During two and a half years in Sind I only remember one nest which on being left came to anything, and that was a nest of the Indus sand-lark, which I spotted as I was riding across the desert without dismounting. Every

other nest disappeared, or at least, the eggs were taken; I have even known a nest from which I had taken the eggs completely vanish. . . . One colony of Saunders' tern, owing to big tides and depredations of animals, did not produce a single flying young one, and a colony of sand-grouse, about fifty pairs, did not raise six young."

A. L. Butler, writing of Ceylon, says (*B.*, X. 285): "One thing I must remark on is the extraordinary destruction of small birds' eggs which goes on in the jungles. In two cases out of three a nest left with eggs is empty when visited the next day, and many a good egg have I lost by waiting to secure a complete clutch."

Magrath records (*B.*, XVIII. 290) that only one out of thirteen dark grey bush chats (*Oreicola ferrea*) succeeded in bringing up a brood.

The above are all the records of those whom I may term casual observers, in that they were paying no particular attention to the subject of the destruction of birds' eggs.

The only people who seem to have attempted a systematic investigation in India of the proportion of eggs laid that yield young which live to fly are O. C. Ollenbach and myself.

As regards my personal observations, I may say that they have convinced me that in the case of almost every species of bird the checks to the increase of its numbers operate chiefly on the eggs and nestlings, that the really critical periods in the life of a bird are those spent in the egg and the nest and the first few days of existence after the nest has been left. As

regards evidence of destruction of eggs and young that I have collected, I may say that I have rarely lived in a bungalow in India in which hoopoes (*Upupa indica*) have not nested. This species seems to lay normally five eggs at a sitting; nevertheless, on every occasion except two on which I have observed parent birds feeding newly fledged young, they have been followed by but one young bird.

In one year I had under observation fourteen nests of *Otocompsa* bulbuls in my garden at Fyzabad, and in all of these either the eggs or young were destroyed by enemies.

In 1919 I noticed that none of the terns that nested on two sand islets in the Ganges, opposite Ghazipur, reared young that lived to fly, while only one young skimmer was reared. There were not less than thirty pairs of skimmers (*Rhynchops albicollis*) nesting on those islets. Taking the average number of eggs in a clutch as three, those skimmers laid ninety eggs. Of these only six or seven yielded chicks, and only one chick was successfully reared. All the other eggs or young were destroyed by crows (*Corvus splendens*).

The notes I made at Lahore during the hot weather of 1921 show that in forty-one nests that I watched, to what I may term a finish, only twenty-seven youngsters lived to leave the nest. As I was not paying particular attention to the matter of the destruction of eggs and young, I did not record full details. The above figures are too favourable, because, although I probably recorded every case of success, it is not unlikely that I failed to record some failures. Most

of the nests in question were discovered because I noticed the parent birds carrying food in the bill, that is to say, at a late period of nesting operations. Even so, I noticed in the case of sunbirds (*Arachnechthra asiatica*) three failures out of three nests, and one out of one in the case of each of the following: red turtle dove (*Œnopopelia tranquebarica*), wire-tailed swallow (*Hirundo smithii*), coucal (*Centropus sinensis*), wren-warbler (*Prinia inornata*), tailor-bird (*Orthotomus sutorius*), white-eye (*Zosterops palpebrosa*), and in the case of the jungle babbler (*Crateropus canorus*) four out of five nests. In three of these I did not discover what caused the disappearance of the eggs; in one the only bird that hatched out was a pied crested cuckoo (*Coccystes jacobinus*) which died in the nest, it probably succumbed to heavy rain that fell when it was almost ready to fly. In the fifth nest five eggs were laid, two were addled and three yielded young which were from seven to eleven days old and in good health when I left Lahore. Assuming that they eventually left the nest and that each hen babbler laid five eggs, we have three young that lived to fly as the result of twenty-five eggs laid.

So much for the open nests. The results of nests in holes in trees were far more favourable. From each of the five hornbills' nests young emerged. I only opened out one of the hornbill's nests after the young had flown, and in this found one dead nestling. It is not improbable that nestlings died in the other nests, for, as we shall see, more often than not some of the nestlings of a brood die of starvation. The other nests

consisted of two of the white-breasted kingfisher (*Halcyon smyrnensis*) and one each of the bee-eater (*Merops viridis*), roller (*Coracias indica*) and magpie-robin (*Copsychis saularis*). All the eggs in the latter disappeared. I did not open out the other nests, but in each some at least of the young lived to fly. It was not until 1922 that systematic observations were made. These M. Mushtaq Ahmad was kind enough to undertake for me. Being an Indian he was able to observe, without attracting the notice that I, as a European, was likely to, and, as he took every precaution to avoid being observed by mischievous urchins and other inquisitive creatures, it is fairly safe to infer that none of the destruction recorded by him was due to human agency, except in the case of the wire-tailed swallows and the paroquets.

The results of these observations may thus be tabulated :—

Name of Bird.	No. of Nests.	When Nest first seen. No. of Eggs.	No. of Young.	Result.
Brown Munia	3	11	3	All destroyed.
Scops Owl	1	1	—	Destroyed.
Little Brown Dove	5	8	2	All destroyed.
Blue Rock Pigeon	10	9	11	1 egg addled. 8 eggs destroyed. 1 young bird killed by falling out of nest. 10 young left nest.
Pied Kingfisher	1	—	3	All 3 reared.
Fantail Flycatcher	1	2	—	2 young reared.

Name of Bird.	No. of Nests.	When Nest first seen. No. of Eggs.	No. of Young.	Result.
Bulbul (Molpastes) .	3	5	2	All destroyed by tree-pies.
Rose-ringed Paroquet .	7	10	—	Young all disappeared, probably taken by bird-catchers.
Wire-tailed Swallow .	25	26	18	23 nests destroyed by a bridge being pulled down. 2 nests deserted.
House Crow . .	6	25	—	1 nest containing 4 eggs destroyed by storm. 3 addled. 18 young reared.
Hoopoe . . .	1	4	—	All 4 reared.
Kite	1	2	—	Both young reared.
White-breasted Kingfisher	1	7	—	4 nestlings reared.
Magpie Robin . .	1	4	—	Eggs yielded young which disappeared.
Grey Partridge . .	2	11	—	1 nest with 6 eggs destroyed. 5 young reared.
Red-wattled Lapwing .	4	15	—	All eggs disappeared.
Shikra	2	—	4	4 young reared.
	74	140	43	52 young reared.

The above observations show that from seventy-four nests observed fifty-two young ones emerged.

The average is probably abnormally low on account of the destruction of twenty-three nests of wire-tailed swallows owing to the bridge being rebuilt. Eliminating these, we have fifty-one pairs of birds rearing fifty-two young ones.

In addition to the above, Mushtaq Ahmad had under observation twelve nests of the sparrow (*Passer domesticus*). At the time of discovery these contained four eggs and thirty-nine young. One egg and six nestlings were subsequently destroyed, the fate of the remainder was not observed.

O. C. Ollenbach, during the months of May and June, 1918, spent a good deal of time in searching for nests with the object of finding out roughly the percentage of success met with by birds in rearing their young. I reproduce his results (*B.*, XXVIII. 801) on the following page.

Thus, twenty-six nests observed by Ollenbach yielded twenty-six young (including a cuckoo). This average approximates closely to that afforded by the more extended observations of Mushtaq Ahmad. Ollenbach remarks that the members of the genus Lanius were the most successful; they reared all their young, namely, thirteen in three nests. He attributes their success to pluck in keeping off despoilers.

Of the birds observed by Mushtaq Ahmad the crows were the most successful. The colony he visited was fortunate in not being victimized by koels (*Eudymanis honorata*). In 1906 I found koels' eggs in six out of twelve crows' nests I examined. One of these nests contained two koels' eggs.

During August, 1918, Ollenbach had over a dozen nests of weaver birds (*Ploceus baya*) under observation.

O. C. Ollenbach's Figures.

Name of Bird.	No. of Nests.	No. of Eggs.	Result.
Purple Sunbird	2	—	All destroyed.
Paradise Flycatcher	3	—	3 young reared.
White-eye	5	—	3 young reared.
Kingcrow	2	—	1 young reared, and 1 cuckoo.
Rufus-backed Shrike	2	—	11 reared.
Common Myna	1	—	Crow destroyed eggs.
Indian Oriole	1	—	Young taken by crows.
Magpie Robin	1	2	Birds "driven" off by pair of mynas.
Bay-backed Shrike	1	—	2 young reared.
Molpastes Bulbul	2	—	2 young reared.
Yellow-eyed Babbler	1	—	Eggs destroyed.
White-breasted Kingfisher	1	5	3 young reared.
White-browed Fantail	2	5	1 nest destroyed by storm; other nest destroyed.
Tailor Bird	1	4	3 eggs destroyed and nest deserted.
Franklin's Wren-warbler	1	3	All destroyed.
	26	19	26 young reared.

These nests were suspended a few feet above the ground from some thorny bushes. On August 14th he noticed that some of the nests contained young which were

being fed by their parents. On the 15th he found a whole family of tree-pies (*Dendrocitta rufa*), two adults and three young, at work devouring the young bayas. He arrived when they were finishing their work of destruction; a hole, just sufficiently large to admit their heads had been torn in each nest at the spot where it bulges.

So far as I am aware, the above are the only systematic observations which have been made with a view to ascertaining the proportion of eggs that give rise to flying young. It is to be hoped that other observers will continue these experiments. To such let me give a word of warning. Beware of the urchin, the inquisitive ryot, and the crow!

If an adult human being or a boy or a crow sees a European prying into a bush, the said boy or crow will certainly, and the adult will probably, visit that bush and destroy any nest he sees therein, as soon as the European has left!

I speak from experience. In 1907 I recorded (*B.*, XVII. 765) how my inquiry into the parasitic habits of the Indian koel was partially spoiled by small boys.

In 1921 I thought I might save myself from the exercise of secrecy by operating in the extensive garden of an Indian friend who was interested in natural history. He told his gardeners that on no account was any nest to be molested. We went through the garden one afternoon and found ten nests. The next day my friend came to me with tears in his eyes and told me that every nest had been rifled!

Thus, the naturalist who attempts an inquiry into

the proportion of eggs and nestlings that are destroyed will do well to act as though he were committing a felony, and let, neither man, nor woman, nor child, nor crow see what he is doing! If there are crows about, which refuse to be driven off, it will be necessary for him to spend much time at bushes that contain nothing and tarry as briefly as possible at bushes that hold nests.

It is submitted that the above observations, although they do not carry us very far, show

(1) That a very large proportion of eggs laid fail to yield young that live to fly.

(2) That birds which nest in holes seem to be more successful than those which lay in the open.

II. THE COMPETITION FOR NESTING SITES

THE observations recorded in the previous chapter indicate that birds which nest in holes are generally more successful in rearing their broods than those which lay eggs in open or exposed nests.

If this be the case, the question naturally arises: How is it that birds which nest in holes are not increasing in numbers rapidly, while the numbers of those which lay in the open are not diminishing?

There seem to be two causes which prevent this. First, birds which nest in holes are not without their enemies. As we shall see, hornbills, crows, mynas and other birds have been seen pulling nestlings out of holes, as have snakes. Moreover, lizards and other creatures prey upon eggs and nestlings that are reared in holes.

The second cause, and by far the most important one, is, that the nesting operations of birds which breed in holes are greatly hampered by the difficulty of securing suitable cavities in which to nest.

This difficulty has been impressed upon me both by my own observations and those of others.

First, let us consider the case of birds that have not learned to excavate their own nest holes.

The number of suitable nest holes is limited, and, as the great majority of species want to nest at the same time, there is much competition for nesting sites, and fights for holes in which to lay eggs are very frequent. Every observer must have witnessed scores of such contests. At Lahore there is, every spring, keen competition between the grey hornbills (*Lophoceros birostris*) and the paroquets (*Palæornis*) for holes in white siris and other trees. Both A. J. Currie and myself have witnessed the former ejecting the latter from the holes they were occupying. I have also seen repeated contests between hornbills and mynas (*Acridotheres tristis*) and between magpie-robins (*Copsychus saularis*) and rollers (*Coracias indica*).

A. J. Currie describes (*B.*, XXIV. 568) how a pair of yellow-throated sparrows (*Gymnorhis flavicollis*) tried in vain to eject a pair of yellow-fronted pied woodpeckers (*Liopicus mahrattensis*) from their nest.

R. M. Betham records (*B.*, XIII. 381) that these sparrows often try to nest in holes occupied by pied woodpeckers or coppersmiths (*Xantholæma hæmatocephala*), but usually fail in their endeavours to eject them and have to wait until those in possession have vacated the tenement. The same observer states that both at Hyderabad (Sind) and Poona the yellow-throated sparrow nests in hollow lamp-posts. In the Punjab this species frequently selects the hollow of a bamboo as a nesting site.

F. W. Bourdillon mentions (*N. and E.*, III. 57) a

case where broadbills (*Eurystomus orientalis*) ejected a pair of grackles (*Eulabes religiosa*) from a hole in a tree stump.

Brooks witnessed eviction by spotted owlets (*Athene brama*) of a pair of Indian rollers from a nest in a bungalow. After a contest, which lasted two whole days, the rollers made another nest in a hole in the same house, but out of sight of the owlets.

Hutton records (*N. and E.*, II. 304) how a pair of brown-fronted pied woodpeckers (*Dendrocopus auriceps*) turned a paroquet out of a nest hole and afterwards left the nest and excavated a nest hole in "the hard oaken gate-post of a wheat field, immediately on a public road, along which servants and cattle were passing and repassing hourly."

C. M. Inglis places on record (*B.*, XIV. 367) the fact that a pair of Indian rollers took possession of a pigeon house after they had driven out the rightful tenants.

The difficulties experienced by birds that lay their eggs in ready-made holes in finding nesting sites is well illustrated by the straits in which the comb-duck (*Sarcidiornis melanonotus*) often finds itself. E. H. Aitken (*B.*, XI. 550) shot one of these birds that had in the oviduct an egg ready to be laid; near by he came upon a nest in a perpendicular bank which held sixteen eggs exactly like the one found in the shot bird. The hole was so situated that the duck had no perch from which to take off when about to enter the nest hole, so that, as Aitken remarks, it must have popped in as a pigeon does. There were no trees in the vicinity, hence the chosing of this unusual site.

nesting of sparrows in a bracket on his drawing-room wall at Lucknow.

B. Aitken gives an account (*N. and E.*, II. 160) of a "large handsome nest" built by sparrows between a pair of deer's horns fixed up on the wall of a fashionable drawing-room. He further writes: "A favourite place for sparrows to build in Bombay is in the globe-shaped hollow at the top of the iron posts of the street lamps, exactly under the glass shade. The hollow is commodious enough, and the neck or mouth is narrow, so the place is admirably adapted to the sparrow's purpose, but must be like a furnace during the heat of the day. Besides, a man goes up twice a day to clean and attend to the lamp, and remains for a minute or two, bustling and fumbling about within four inches of the nest. Then, again, the gas is blazing all night with a glare that would astonish any bird more susceptible than *Passer domesticus*."

The hoopoe (*Upupa indica*), in default of more suitable sites, often nests on the floor of a deserted hut, which it enters through the space between the door and the floor or the lintels.

The brown-backed robin (*Thamnobia cambayensis*) builds in all manner of strange places, often between the upright stems of a cactus bush, or between two bricks in a kiln. Kerosine-oil tins or watering pots that have been discarded are frequently utilized. C. M. Betham records (*B.*, XII. 778) a pair rearing one brood in an old kerosene-oil tin, and then laying more eggs in the same tin; these produced young which disappeared. A third brood was not attempted that

year, but in the following season two eggs were laid in the tin. These yielded young which came to an untimely end.

A. Anderson cites (*N. and E.*, II. 73) a still stranger site, namely, an old piece of cloth that had been thrown over a bough and which formed a sort of loop or bag below, in which the nest was built.

F. Field records (*B.*, XIV. 611) finding eggs of the robin in the nest of a babbler (*Argya candata*).

Robins and mynas (*Acridotheres tristis*), when unable to find a suitable hole, are often reduced tothe necessity of building on a ledge or rafter, and, as they are not skilled in the science of architecture, their eggs and young, in such circumstances, are often destroyed by falling on to the ground below. In default of holes or ledges, mynas will build in creepers and even in trees.

B. Aitken records (*B.*, XIV. 367) that a nest of young mynas was reared above the hinge of the signal at a railway station, despite the fact that an arm of the signal moved every time a train passed.

C. W. Beebe (*A.M.*, December, 1907, p. 48) relates a similar case where a pair of blue birds (*Sialia sialis*) nested in one of the signal balls at Reading, Massachusetts: "Here they successfully raised two broods of young, in spite of the fact that the ball was lowered fifty times a day for passing trains. Every time it descended the parents flew out and waited . . . until the ball was raised again."

E. A. Butler at Belgaum found (*N. and E.*, I. 376) several nests of the black-headed myna (*Temenuchus*

pagodarum) in old nest holes of barbets. "Two of the nests," he writes, "were in the nest holes of barbets from which I had taken eggs the month previous."

A. J. Currie gives (*B.*, XXIV. 600) a most interesting account of the difficulties experienced by birds in finding nesting sites in two newly built towns in India, namely, Lyallpur and Dera Ghazi Khan.

"Lyallpur," remarks Currie, "is a comparatively new canal colony where the bungalows are mostly newly built and do not afford facilities in the way of holes for nesting sites . . . and where the trees mostly consist of plantations of young shesham, a hard wood remarkably devoid of holes."

At Lyallpur the rose-ringed paroquets (*Palæornis torquatus*) were hard put to it to secure nesting sites. They prospected Currie's bungalow in vain, and eventually had to make do with a disused drey of a squirrel.

At Dera Ghazi Khan the bungalows are all new and there are few trees except young ones. At that station Currie found a spotted owlet (*Athene brama*) sitting on a egg in a squirrel's nest in a small dead tree.

Curious nesting sites, such as those mentioned above, are, I submit, chosen, not because the birds in question have peculiar ideas on the subject of nesting places, but in default of more suitable spots.

The fact that birds of which the eggs have been taken often lay again in the same hole perhaps affords further evidence of the difficulty experienced in finding suitable holes.

B. Aitken writes (*N. and E.*, I. 379) of a pair of

common mynas (*Acridotheres tristis*), they "clung tenaciously for two years, from June, 1863, to August, 1865, to a hole in some matting in the upper verandah of a house in Bombay. During this period they hatched six broods, one of which I took and another was destroyed, by rats perhaps. I had a strong suspicion that more than one set of eggs was destroyed besides. . . . Every alternate brood of young contained an *albino*, pure white with pink eyes, being three in all. Every time a new set of eggs was laid, a new nest was built on top of the old one. I once tore down the whole pile, as it was infested with vermin, and found that seven nests had been made, one upon another, showing that the mynas must have occupied the hole long before I noticed them."

P. A. Buxton shows (*Animal Life in Deserts*, p. 131) that, on account of the difficulty of finding nesting sites, birds that nestle in holes are found in the deserts of Arizona and California, only in places where the saguaro or giant cactus (*Cereus giganteous*) grows, and by the riverside where there are willows. In this connection Grinnell writes: "It is clearly apparent that the critical feature of the saguaro which prescribes its avian dependents is nothing less than the favourable opportunity offered for the excavation of safe retreats in its trunk; and only the two woodpeckers are equipped for making the excavations. So that without the woodpeckers to make holes, the other birds would be no better off for the presence of the saguaro."

Birds which excavate nest holes are better off in

some respects, but worse in others, than birds that utilize ready-made cavities.

The nesting operations of species that dig holes in cliffs and sandbanks are restricted to the areas where such cliffs and banks occur. In localities where these do not exist the birds in question either cannot nest or must adopt unusual sites. This perhaps explains why the Nicobar kingfisher (*Sauro-patis occipitalis*) builds in deserted termites' nests attached to trees. As these nests rarely exceed 30 inches in diameter, the passage leading to the kingfisher's chamber is usually only 6 inches in length.

The white-breasted kingfisher (*H. smyrnensis*) often dwells far from streams and lakes in places where cliffs and banks are not available, in consequence this species sometimes burrows in wells. Hume records (*N. and E.*, III. 15) that in Rajputana six eggs of this bird were brought to him from a nest hole situated in a well nearly 100 feet below the surface of the country. The reason why the makers of the nest went to so extraordinary a depth was that the upper 90 odd feet of the well passed through very loose soil, where the well was lined with masonry in which it was not possible for the kingfishers to pierce a hole. "I have also," writes Hume, "taken the nest (and here the hole was only 18 inches deep) out of the mud bastion of an old native fort, some 20 feet above the level of the water in the moat, and, again, in an old mud wall of a deserted house far away in the jungle."

Stuart Baker records that in Cachar this species often makes a nest of moss in a crevice between stones

or boulders. The reason for this would appear to be that the sand of the cliffs is so soft that it is not feasible to burrow into it.

J. R. Cripps describes (*N. and E.*, III. 11) one nest of the stork-billed kingfisher (*Pelargopsis gurial*) excavated in the earth clinging to the roots of a dead tree that had been blown down, and another nest near by in a dead and rotten chumpa tree. He had this tree cut down and found the wood so decayed that the trunk when felled "went to shivers," and the young in the nest were destroyed. There was neither river nor tank within half a mile of these nests.

Bee-eaters (*Merops viridis*) have to leave both Bombay and Calcutta during the breeding season, because they are unable to find nesting sites in and about those cities.

The cutting of a nest is a laborious process for a woodpecker or a barbet. In order to minimize the energy expended, the excavation seems usually to be made at a spot where the wood is partly decayed. Every ornithologist must have remarked upon the large number of these nests that are left unfinished. In some cases the cause of the desertion of the hole appears to be the fact that the inner wood is hard.

The excavation of the nest cavity must be a very arduous operation to a barbet, since this species has not the chisel-like bill of the woodpecker. This is doubtless why barbets seem, as far as possible, to shirk the work of hewing out a nest.

The same nest hole is used year after year; and

there is often fighting for the possession of an old nest hole. F. R. Blewitt describes (*N. and E.*, II. 331) such a contest that took place between two male coppersmiths (*Xantholæma hæmatocephala*). The bone of contention was excavated in the decayed branch of a neem tree. Three times did the rivals come to grips on a branch and fall to the ground. "In the fourth attempt to reach the branch the weaker bird, from exhaustion, failed to do so; it then flew and perched on a low bamboo framework. The other immediately followed, and in the renewed contest seized his antagonist firmly by the beak, shook him off the bamboo, and kept him suspended (by the beak) for over a minute, when both fell to the ground. The weaker bird, exhausted as he was by the prolonged fight, recovered himself slowly and flew away, while the victor returned to the nest."

D. D. Cunningham points out (*Some Indian Friends and Acquaintances*, p. 107) that coppersmiths are always on the outlook for chances of appropriating the nest holes of the blue-throated barbet (*Cyanops asiatica*). This fact, he writes, "is so well recognized by the proper owners as to render them very intolerant of the neighbourhood of coppersmiths when excavating or occupying a burrow."

Sometimes other species that have a nest in a hole in a tree resent the presence of barbets. Cunningham (*loc. cit.*) describes how the excavation of a pair of coppersmiths was seriously retarded for some time by a couple of dayals (*Copsychus saularis*).

Barbets are usually careful to see that the aperture

to their excavation is so directed that the nest cannot be flooded by heavy rain.

Birds that nest in natural hollows or in ready-made cavities, however, often have their nests flooded by rain.

Of the nests in excavated holes in river banks great numbers are flooded when the river rises in the spring (*vide* p. 229).

Nests in holes are usually more or less insanitary, and it is probable that nestlings born in such are more subject to diseases than those reared in an open nest.

The above considerations perhaps explain why it is that birds which nest in holes, although their young are less liable to destruction by enemies, have not altogether or largely ousted those that lay their eggs in exposed situations.

The difficulty of finding suitable nests in which to deposit eggs must operate as a check to the increase of the population of parasitic cuckoos, especially of such species as the Indian koel (*Eudynamis honorata*) and the pied-crested cuckoo (*Coccystes jacobinus*) which confine their attention almost exclusively to one description of host.

The parasitic cuckoo, unless its egg is to be wasted, must find a nest in which the full clutch of eggs has not been laid. If it deposits an egg in a nest in which the legitimate eggs are in an advanced stage of incubation, these, or those of them that are not removed by the cuckoo, will yield young before the cuckoo's egg incubates and this will become addled, or, should it

hatch, the young cuckoo will not be strong enough to compete with its elder foster-brethren for food and will die of starvation.

There is no lack of proof that cuckoos are sometimes hard put to it to find suitable nests for their eggs. It is not an uncommon thing to find from two to four koels' eggs in one crow's nest. A. E. Jones came upon a nest which held nine koels' and four crows' eggs. The koels' eggs were of three types, from which it would appear that three koels were using that particular nest.

J. R. Jacobs found in one crow's nest seven koels' eggs of two types.

A. Begbie records (*B.*, XVI. 746) eight koels' eggs and one crow's egg in the same nest.

As crows are far more numerous than koels, it may be asked why it is that koels are under the necessity of placing more than one egg in any nest. The answer appears to be that in some localities, at any rate, the laying season of the crow does not synchronize exactly with that of the koel. E. H. Gill points out (*B.*, XXVIII. 1070) that in the U.P. nests of house crows (*Corvus splendens*) in which eggs are laid as early as the beginning of June are comparatively immune from the koel.

B. B. Osmaston gives some interesting notes (*B.*, XXIV. 36) on the trials of the laughing thrush (*Garrulax moniliger*) at Maymyo. He records three nests of this species. The first of these held :

Two thrush nestlings, just hatched.

Two nestlings of the red-winged crested cuckoo

(*Coccystes coromandus*), one about four days old and the other two.

One nearly incubated egg of *C. coromandus*.

One addled egg of the large hawk-cuckoo (*Hierococcyx sparverioides*).

In the second nest he found :

Three thrush nestlings.

One egg of the large hawk-cuckoo.

One egg of the red-winged crested cuckoo.

The third nest contained :

One egg and one young of *C. coromandus*.

One egg of the large hawk-cuckoo.

Three thrush nestlings.

In this last nest the thrush nestlings died of starvation and the two eggs came to nothing, but the cuckoos were reared.

J. M. D. Mackenzie records (*B.*, XXV. 743) very similar experiences at Maymyo. Of the five nests of *Garrulax moniliger* found by him, four contained each one egg of the large hawk-cuckoo and one of the red-winged crested cuckoo, while the fifth held :

Four eggs of the red-winged crested cuckoo.

One egg of the large hawk-cuckoo.

One thrush's egg. This was punctured.

Mackenzie noticed that the red-winged crested cuckoo frequently punctures the eggs of its dupes.

Here we have cases where a cuckoo has placed its eggs in a nest in which another cuckoo has already laid.

In some localities this does not happen as an accidental occurrence, but frequently, indicating that in such places many more cuckoos' eggs are laid than

there are nests to hold them. In the case of cuckoos of which the nestlings do not eject the other eggs or young, two or even more cuckoos may be reared in the same nest, hence this laying of several eggs in one nest is not so disastrous as it would be in the case of the common cuckoo (*Cuculus canorus*).

We know that the common cuckoo sometimes lays as many as twenty eggs in a season. If these were all to come to maturity the country would be so overrun with cuckoos that there would not be nearly enough nests to take the cuckoo's eggs. As it is, this cuckoo, in preference to laying more than one egg in the same nest, victimizes a great variety of birds.

As there is no reason to suppose that adult cuckoos are more liable to be destroyed than are other birds, and as the cuckoo, unlike other kinds of birds, does not place all its eggs in one basket, or, rather, one nest, it follows that the population of cuckoos in any area is largely regulated by the number of suitable hosts' nests in that area. A large number of cuckoos' eggs are destroyed annually owing to the fact that they are laid in unsuitable nests, or on the ground because no nest of any kind is available.

In connection with the subject of competition for nesting sites, we must bear in mind that the question of food supply renders it essential that each pair of nesting birds shall have around the nest an area in which it is, so to speak, free to seek for food. This fact, which is dealt with in Chapter V (see p. 55), increases the difficulty experienced by birds in securing nesting sites. A tree, for example, may present ten

cavities, each suitable for a nest, but if every one of these cavities were tenanted at the same time by a brood of young birds, it would be physically impossible for each of the ten pairs of parent birds to find the large quantity of food necessary to feed their young.

III. UNMATED BIRDS

IT is obvious that any cause which prevents birds from mating at the nesting season is as effective a check to the growth of the avian population as an agency which destroys the eggs or nestlings of an equal number of birds that have paired.

That there are a large number of birds which do not nest every year is proved by abundant evidence.

First, there is actual observation of unmated birds at the nesting season. I must admit that I myself am not in a position to adduce much direct evidence of this in India, because when residing there I did not pay any attention to the subject, not then realizing its importance. My observation, however, shows that the jungle babblers or "seven sisters" (*Crateropus canorus*), when they have eggs or young in the nest, leave the little flocks in which they go about, nevertheless there is no season of the year in which these flocks do not exist. As the nesting season in any locality does not last long, it is, I think, clear that all the birds of this species do not breed every year. As regards England we have better direct evidence in the observations of Robert Service, quoted by Howard, and Miss E. L. Turner. Service found in certain seasons, in Dumfriesshire, flocks of from ten to fifty

unmated sedge-warblers, which, from the time of their arrival in May until the middle of July, haunted reed-filled spaces among stagnant streams. These flocks appeared to him to be composed of loosely attached individuals of a migrant flock that had failed to find things congenial enough to induce them to disperse. I, however, incline to the opinion of Howard, that they were composed almost certainly of males that had failed to secure breeding territories and females which had not succeeded in finding males in possession of such territory.

Miss E. L. Turner, who acted as Watcher at the National Trust Island of Scolt Head on the Norfolk coast, has also observed that numbers of birds do not mate at the nesting season. On this subject she has written *in epistola*, "Such species as oyster-catchers strike one most because they are so much in evidence round our coasts. . . . It is difficult in the present state of our knowledge to know how long this species takes to reach maturity. Flocks of upwards of a hundred may be seen round the coast throughout the breeding season. We know that nature is very wasteful. I think there must be numbers of all kinds of birds to supply losses."

In addition to what I may call direct evidence of the existence of these unmated birds there is a great deal of indirect evidence. When one of a pair of nesting birds is shot the survivor seems, in the great majority of cases, to find a new mate and continue the nesting operations.

So general is this habit, that it is not feasible to

quote all the recorded observations. The following are a few :

Darwin informs us, in *The Descent of Man*, that Lord Lubbock's gamekeeper repeatedly shot one of a pair of jays and never failed shortly afterwards to find the survivor rematched. The same phenomenon has been observed in several cases where one of a pair of carrion crows, peregrine falcons, kestrels, golden eagles, or owls has been caught or shot.

"I could," writes Darwin, "add analogous cases relating to the chaffinch, nightingale and redstart. With respect to the last bird (*Phœnicura ruticilla*) a writer expresses much surprise how the sitting female could so soon have given effectual notice that she was a widow, for the species was not common in the neighbourhood. Mr. Jenner Weir has mentioned to me a nearly similar case at Blackheath ; he never sees or hears the note of the bullfinch, yet when one of his caged males has died, a wild one in the course of a few days has generally come and perched near the widowed female, whose call note is not loud. . . . One of a pair of starlings was shot in the morning, by noon a new mate was found ; this was again shot, but before night the pair was complete ; so that the disconsolate widow or widower was thrice consoled during the same day."

Darwin further states that Mr. Engleheart shot in one season thirty-five starlings from the same nest ; these consisted of both males and females, but in what proportion he could not say : nevertheless, after all this destruction a brood was reared.

In *Bombay Ducks*, I have recorded a case where a man, in order to deter a pair of sparrows from nesting in his verandah, slew the cock. The hen replied to this by returning in a few minutes with a second husband. He shared the fate of number one. Nothing daunted, the hen returned with number three. He, too, was gathered unto his fathers shortly after his arrival, but was soon replaced. And this process continued until that hen sparrow had lured six cocks to their doom. At that stage the man in question stayed his hand. Gilbert White of Selborne had a similar experience. His grievance against a pair of sparrows was that they deprived the house-martins of their nests. He, therefore, shot one of them, but the one that was left, "be it cock or hen, presently secured a mate, and so for several times following."

R. M. Adam writes (*N. and E.*, III. 109): "On one or two occasions I have shot one of a pair of spotted owlets (*Athene brama*)—that were nesting in the thatch of his house—and the survivor found a mate within the next two or three days."

Davidson and Wenden (*N. and E.*, III. 143) found a nest of Bonelli's eagle (*Nisaëtus fasciatus*) containing one young bird. The hen was shot by one of them and within two days the male appeared with another female, and the young one disappeared. The pair went to another old nest of enormous size on an adjacent tree.

G. F. L. Marshall (*N. and E.*, III. 284) shot the male of a pair of nesting whistling teal (*Dendrocycna javanica*). On visiting the nest the next day he

found that the female had procured another mate.

C. M. Inglis records (*B.*, XV. 74) that when he shot a female white-necked stork (*Dissura episcopus*) on the nest, the cock soon secured a new mate and the pair reared young.

G. A. Pinto accidentally killed at Lahore a female yellow-throated sparrow (*Gymnorhis flavicollis*) which was incubating. He observed another hen at the nest on the following day.

Miss E. L. Turner writes: "I find that any bird that loses its mate has no difficulty in finding another, at any rate, during the breeding season." Again she writes: "As far as my own observations are concerned, I find that a bird that loses its mate while it has eggs almost always deserts the nest and finds another mate very soon and nests again elsewhere. If, however, a bird is left to bring up the young it will generally do this alone. On the other hand, this is not invariably the case. It depends on the age of the young. If these are well advanced in the nest, the surviving parent continues the feeding, but it obviously would find it almost impossible to do this if the young were only a few days old. You have to remember . . . that individual birds vary in temperament and habits."

Lady Edith Douglas Pennant writes (*B.N.*, June, 1912, p. 157) of a pair of pope cardinals in her aviary that they hatched out three chicks "which did well for about a week or ten days, when one evening, I caught a giant wydah in the act of killing the hen,

and, as after this sad event, the cock took no notice of his family, we killed them instead of leaving them to starve. I thought this rather strange, as the cock bird was most assiduous in his care of the young bird fully reared from the previous nest; till it was able to fend for itself he never left it, in fact, was quite a model parent." In this instance there was no other hen available to mate with the bereaved cock.

The only recorded instance that I have come upon of the survivor of a pair of wild nesting birds failing to secure another mate is that of a cock white-throated warbler (*Dumetia albigularis*) shot by J. L. Darling (*N. and E.*, I. 95). Darling states that the cock continued to sit on the eggs for three days. He does not say what subsequently happened.

The observations set forth above show (1) that at the nesting season there are numbers of birds which have not mates, (2) that some, at any rate, of these unmated birds mate readily when an opportunity presents itself.

Darwin suggests that these second husbands or wives may be those whose mates have been killed or have succumbed to illness. He further is of opinion that "birds which have had their nests destroyed, or barren pairs, or retarded individuals, would easily be induced to desert their mates, and would probably be glad to take what share they could of the pleasures or duties of rearing offspring although not their own."

Each of these suggestions would explain the existence of a certain number of eligible partners for bereaved spouses.

We must also bear in mind, that all the individuals of a species do not, as a rule, become ready for breeding simultaneously, so that it is possible that the bereaved cock or hen, as the case may be, is able early in the season to secure as a second spouse an individual which would ordinarily have bred later; similarly, towards the end of the breeding season it is likely that a bird that has already brought up a family that year would be willing to enter into a second alliance.

Another suggestion which, if true, would explain the existence of a number of unmated birds is that the fowls of the air, like human beings, are not willing to mate with the first individual of the opposite sex they see, that they refuse to pair until they meet with another bird pleasing to them. Against this suggestion, is the apparent facility with which a new mate is found. If in such cases there be any courtship it must be exceedingly brief. Of course, it is possible that the bereaved bird has some means of communicating to other birds that it has a nest and eggs or young and is in urgent necessity of a helpmate. In this connection it is of interest to note that in certain cases where the cock has been repeatedly shot, the hen has eventually brought in, as her mate, a cock in immature plumage.

Doubtless some of these unmated birds are immature individuals, not in a fit condition to breed, possibly some are too sickly to do so. Even allowing for all these possibilities, I think we are forced to the conclusion that the reason why most of these birds are in a state of "single blessedness" is the inability of

the cocks to secure breeding areas and of the hens to find cocks in possession of such areas.

So little attention has been paid to this subject of unmated birds at the nesting season that I am not in a position to state in the case of a single species what the proportion of unmated birds is. It probably varies with the species and the abundance of food. There is, however, evidence which tends to show that the proportion is considerable. Thus, Miss E. L. Turner says of oyster-catchers : " Flocks of upwards of a hundred may be seen round the coast (of England) throughout the breeding season." In one area Service saw hundreds of unmated sedge-warblers. Englehart's experiments show that in one locality there were at least thirty-five unmated starlings, so that, unless there were more than seventeen pairs of starlings with nests, the number of unmated birds in that particular locality exceeded that of the mated ones.

It is to be hoped that naturalists in India will pay especial attention to this subject in future. In the case of the seven-sisters (*Crateropus canorus*) it should not be difficult to take a certain area and obtain a rough census of the seven-sisters inhabiting the locality, and then in the hot weather and rains to count all the nests, and, at the same time, watch each flock. Thus it should be possible to arrive at some idea of the proportion of birds of this species that mate to those that do not. A less laborious, but a cruel, method would be to locate a number of nests of any given species and shoot one of each pair and continue the process so long as the nesting operations

last, and thus ascertain the number of lost mates replaced.

Personally I should be surprised if the result of such experiments showed that the proportion of unmated birds to mated ones was smaller than one to three.

IV. NEST DESERTION

WE have noticed the following checks to the growth of the avian population which operate on eggs and nestlings: the great destruction of eggs and nestlings that takes place, the difficulty in securing nesting sites in the case of birds that rear their young in holes, and, in the case of parasitic cuckoos, the difficulty in finding suitable hosts' nests.

There is yet another check which operates on eggs and nestlings, and that is the frequency with which birds desert their nests.

Every ornithologist must have observed cases of nest desertion. Not infrequently the nest is deserted before any eggs have been laid. Some species seem far more prone to desert than others. Some will leave the nest for good if a human being handles their eggs, others will not. Some will incubate strange eggs that have been substituted for their own.

The cases of nest desertion that occur are by no means all due to the fact that human beings have meddled with the eggs.

In many cases the observers who have recorded the desertion of nests are unable to give any reason for this behaviour of the birds. Thus, S. M. Robinson states (*B.*, XXIII. 653) that in Burma, Tickell's

staphidia (*Staphidia striata*) seems to desert the nest without any cause. He found many nests containing two or three eggs deserted. Writing later (*B.*, XXV. 843) he says: "I once found twelve nests of Tickell's staphidia within a space of twenty yards all deserted and many with addled eggs therein."

Butler records (*N. and E.*, I. 154) finding many nests of the iora (*Ægithina tiphia*) being built during the hot weather and rains, but all except one were deserted before they were completed.

S. B. Doig writes (*N. and E.*, I. 247) of the long-tailed grass-warbler (*Laticilla burnesi*): "After this I found several nests, but they were all building, and were, one and all, deserted, though in many instances I never touched the nest, often never saw it, as, on seeing the birds flying in and out of the grass with building material, I left the place and returned in ten days' time, but only to find the nest deserted. In one case where a single addled egg had been laid, I found that the bird before deserting the nest had broken the egg."

R. M. Betham writes (*B.*, XI. 316): "I wonder if other egg-collectors have had the same experience as myself. I have found at least half a dozen or more of the nests of the white-spotted fantail (*Rhipidura pectoralis*), but, as yet, have not obtained a single egg. The same fatality appears to hang over many other species. In the case of the iora (*Ægithina tiphia*) I have found a dozen nests or more and have only got three eggs; they appear to construct many nests and then desert."

Nest Desertion

J. Davidson says (*B.*, XI. 656) of the black-headed babbler (*Rhophocichla atriceps*): "It seems to spend most of its time building numerous nests, as one finds eggs or young in only one out of about a dozen nests."

There are many cases of nest desertion for which a clear explanation is forthcoming. I have recorded (*Birds of the Plains*, p. 66) how a tailor-bird (*Orthotomus sutorius*) began to build a nest in a Dracæna plant growing in a verandah at Lahore. When the nest was about three-parts finished the little builder left it and began to make another in a Dracæna in the same verandah about two yards from the first nest. She had not made much progress in respect of the second nest before she returned to and completed the first one. The cause of this behaviour was a dog. This was ordinarily chained up at one end of the verandah, out of reach of the first nest. On the day of the desertion of this, the dog was tethered at a place within reach of it. On the following day the dog was chained up in the usual place. It was the fact that her nest was within reach of the dog that caused the tailor-bird to give it up. When it again was out of danger she discarded the new nest for the more advanced original one.

A. L. Butler records (*B.*, X. 308) that a Ceylon swallow (*Hirundo hyperythra*) deserted its nest in his verandah because his cat "took such an absorbing interest in it."

A. Anderson informs us (*N. and E.*, I. 297) that a pair of wren-warblers (*Prinia stewarti*) deserted a nest in a geranium in his verandah because the leaves that

had been pierced and sewn began to wither; a few days after desertion the whole structure came down bodily.

As has been stated above, some species are far more prone than others to desert the nest.

At the one extreme stands the black-headed sibia (*Lioptila capistrata*) which deserts upon the slightest provocation, and at the other we find sparrows, doves and house martins, which build nest after nest at the same spot although each is pulled down as soon as it is made.

At Hissar in 1921 a pair of little brown doves (*Turtur cambayensis*) decided to build their nest on a dressing-table in a bedroom. The owner of the table had the materials cleared away daily, but the birds persisted. After a few days of this the house cat caught and devoured one of the doves, the survivor then gave up the attempt.

A. G. Butler records (*A.M.*, May, 1908, p. 211) the case of a pair of house sparrows which persisted in building a nest in a roller blind. "Every morning the blind was lowered to shade the room from the sun, and the nest fell to the ground: but no sooner was the blind drawn up than all the rubbish was replaced. This continued for nearly a month, and it was only after two or three wet days, which had enabled the birds to make considerable progress, when the lowering of the blind again threw out the materials that they were convinced of the futility of their efforts."

Not only do different species vary in the readiness with which they desert the nest, but individuals of

the same species display great differences in this respect.

Hall, in the *Useful Birds of Southern Australia*, suggests that the prodigality in nest-making which some species exhibit affords protection from prying animals ; that an enemy, after having searched several nests without finding anything, will abandon the search before it has reached an occupied nest.

This may possibly explain some cases of nest desertion. In most instances, there is, I believe, some other reason for the desertion. It would certainly be a lesser evil for a small bird, of which the nest has been discovered by a crow or other predacious creature, to abandon it and build elsewhere than to continue with the old nest only to have its eggs or young devoured at a return visit of the marauder. On the other hand, every time a bird deserts a nest and begins another its chances of rearing a brood that season are lessened on account of the loss of time involved, because the breeding season is comparatively short. Birds that are too prone to desert the nest, that is to say, those that desert on the slightest provocation and often unnecessarily, are less likely to rear offspring than those of less nervous temperament. Thus, natural selection would tend to eliminate individuals which are on the one hand excessively nervous and on the other the exceedingly obstinate.

Whatever be the cause, the fact that nest desertion is so frequent affords evidence of the difficulties encountered by birds when attempting to rear a brood.

S. D. Doig and several other observers have noticed that some birds destroy one or more of their eggs before leaving a nest from which they are driven by a man being climbing the tree in which the nest is placed.

This habit is probably due to the fact that birds at the nest are in a state of great mental instability.

It is there that their natural instinct of self-preservation finds itself confronted with an opposing instinct—with what may be termed the parental instinct. When the latter instinct is the more powerful the nesting bird will fight a creature from which it ordinarily would flee in terror. When the instinct of self-preservation is the stronger the bird deserts its eggs or young in face of danger. If the two be equally balanced the bird, when its eggs or young are attacked, becomes temporarily mentally unbalanced, and in such a condition it will flop about on the ground as though its wing were broken or it were in a fit. When a bird with eggs or young behaves in this way many believe that it is deliberately feigning injury to draw off from its young the attention of the intruder. I cannot believe that any bird has sufficient knowledge or intelligence to feign deliberately that its wing is broken.

I am inclined to regard the breaking of one of its own eggs, by a bird when frightened off its nest by a man climbing up to it, as the act of a bird which has temporarily lost its mental balance owing to the clashing of two very powerful instincts.

The various checks to the growth of the avian

population which have been noticed above are less effective than they would otherwise be, because, in nearly every case where eggs or nestlings are destroyed, a bird lays a fresh clutch, and when it deserts the nest it makes a fresh one. Were this not so the great destruction of eggs and nestlings that takes place would long ago have caused many existing species to become extinct.

On the other hand, if the breeding season lasted throughout the year the destruction that goes on would not suffice to prevent almost every species increasing rapidly in numbers, because even though every pair of birds to have, say, ten clutches of eggs destroyed annually, they would rear the eleventh.

As the nesting season is comparatively short in most species, the loss of the three clutches prevents an average pair of birds from rearing a brood in that particular season.

In this connection mention may be made of a phenomenon to which very little attention seems to have been paid, namely, the manner in which the reproductive activities of birds are affected by surrounding conditions.

R. I. Pocock records (*A.M.*, November, 1908, p. 29) an interesting note on this subject in connection with the breeding of Heck's Curassow (*Crax hecki*) in captivity. "The curassows in question," he writes, "furnished an admirable illustration of a phenomenon, familiar no doubt to most aviculturalists, but one which is none the less remarkable for all that. I refer to the wonderful extent to which the reproductive

activities of birds appear to be influenced, both in the way of suppression and stimulation, by what seem to us to be trivial factors in their environment, factors indeed which the inexperienced would declare to be quite inadequate to produce the results that apparently follow from them. For instance, the pair of curassows bred in 1906 and in 1908 when a suitable site and nesting materials with which to build were at hand. In 1907 they evinced no sign of even wishing to breed when these desiderata were not available. Again, when the first two eggs of 1908 were smashed, the loss was made good in a few days ; and no one will suppose that the second lot would have been produced but for the accident which robbed the birds of the first clutch. This suggests that incubation acts upon the organization of the hen in some way adverse to the development of eggs, and conversely that the cessation of incubation and of family cares act as a stimulus to the organs concerned in egg-formation, provided that the time of the year be favourable. Similarly, the breeding of the birds in 1906 and 1908 and their sterility in 1907, under the conditions mentioned above, show that what is true, if true it be, of incubation, is no less true of nidification. The two indeed apparently influence the hen in a manner analogous to that produced upon some female mammalia by lactation. But the intimate physiological connection between lactation and reproduction in mammalia brings this phenomenon within the scope of our comprehension. Nidification and incubation, on the contrary, are merely manifestations of particular

instincts: they are occupations followed in obedience to certain innate promptings and, as such, fall into the category of psychical, not of physiological, phenomena. Yet, if the supposition be correct that the reproductive activities are affected by these occupations, the fact constitutes a problem in physiology which, so far as I know, cannot be quite matched in the mammalia, although an approach to it is seen in the internal effects produced by the emotion of fear or in the stimulus to salivation supplied by the sight of appetizing food.

"I have merely cited nidification and incubation as possible causes in determining the maturation of eggs, because the curassows furnished the data. I do not doubt that other factors, apart, of course, from food and bodily health, produce the same apparent results."

V. FOOD SUPPLY

AS Darwin pointed out, the amount of food of each species gives the extreme limit to which it can increase. In India the quantity of food available for the avian population depends upon the rainfall, and as this varies from year to year so does the supply of food.

In India nearly the whole of the rain falls between June 15th and September 15th, except in the south-eastern parts of the country where the chief rainfall occurs in November and December.

Although the rainfall varies from year to year, it is consistently much heavier in some parts of the country than in others; thus the average rainfall measures about 2 inches in the Rajputana desert and some 300 inches in the hilly parts of Assam. Speaking generally, the rainfall increases as we pass from west to east and is greater in the hills than in the plains.

Throughout the major part of the country the air is saturated with moisture from the third week in June until early September. From October to June the only rain that falls consists of a few showers during the winter months. From March till the middle of June the weather is very hot and dry, the thermometer

ranging from about 80° to 118° in the shade, and the countryside becomes brown and parched.

With the first fall of the monsoon rain, which usually occurs in June, the sun-baked soil becomes soft, and the cultivators plough their fields and sow seeds which produce crops in the autumn; these are chiefly rice and millet. The quantity and quality of these autumn or *kharif* crops depend on the amount of the rainfall, particularly of the later rainfall. If this be altogether insufficient, as not infrequently happens, the crops wither and die. As soon as the *kharif* crops are harvested, those that ripen in the spring are sown; these in Northern India are mainly wheat, barley and peas. They are known as the *rabi* crops. If the monsoon rains have failed or have ceased very early, the ground by November is so hard that it is possible to plough it and sow the spring crops only in areas where irrigation is possible.

Once sown, the *rabi* crops are able to ripen without any rain falling, the dew that forms during the cold winter nights suffices to provide moisture adequate to produce an indifferent crop. If, however, as often happens, some rain falls in December or January, the outturn of the *rabi* crops is enormously increased. Irrigation, except in very abnormal years, gives a still further increase, so that wherever possible irrigation takes place. This may be from canals, wells or tanks. The canals and wells are the handiwork of man; most of the tanks are natural depressions which occur in the plains throughout India. Into these natural hollows much of the monsoon rain collects to form

small lakes or *jhils*, as they are usually termed. The shallower and smaller of these lakes become completely dried up long before the next monsoon, owing to evaporation and to the water being drawn off in order to irrigate the surrounding fields.

Now, the effects of a failure of the monsoon are, first, the destruction of the *kharif* crops; secondly, a considerable restriction of the area sown with *rabi* crops; and thirdly, the area of *rabi* that is sown yields a comparatively small return because some of the water from the wells, canals and lakes is drawn off to soften the ground to make it arable, and there is often little available for irrigation; moreover, the tanks, rivers and wells were not fully replenished by the weak monsoon. Thus the failure of the monsoon causes a very great reduction of the food supply of men, beasts and birds, and if the failure occurs in two successive seasons the scarcity develops into famine.

When attempting to estimate the effect of a bad monsoon on the feathered folk of India, it is necessary to bear in mind two facts:

1. Every year the demands on the food supply available for birds increases greatly during the nesting season.

2. That by no means all the members of every species of bird breed every year.

As the great majority of the birds that nest in India do so during the hot weather and rainy season, the indigenous avian population requires at these seasons, that is to say, from April to September, a supply of

food far greater than that which it needs during the remaining months of the year.

Every pair of birds which has young to provide for, requires, in order adequately to provide for its young, anything from double to quadruple the quantity of food it needed before its young were hatched. If all the young that are hatched came to maturity, it is apparent that this extra demand would continue after the young were fledged, unless there were a very high rate of mortality among adult birds.

What actually happens is that the vast majority of birds which are hatched do not live to fly; in consequence, although there is, every year in spring, a sudden greatly increased demand for food, this extra demand gradually diminishes as the nestlings are killed off; so that by the autumn the demands on the food supply have fallen almost to the level of the demand before the nesting season began; it does not fall to quite that figure, because some young live to fly, but while they are still in the nest there are casualties among the adult birds. These casualties continue throughout the winter months and occur both among the birds of the year and the older ones, so that, by the time the next breeding season arrives, the demand for food has usually fallen to the level at which it stood twelve months previously.

As a partial set-off to the great demand for food on the part of the indigenous birds that occurs every spring, there is at that season the exodus from India of the millions of birds which are winter visitors to that country—the geese, ducks, snipe, quail and many

others. The set-off in question is, however, only a partial one; the departure of these winter visitors does not set free nearly enough food to satisfy the appetites of the millions of nestlings which suddenly come into being.

The reason why the majority of birds nest in India during the spring and the rainy season, is not so much the departure of the migrants as the fact that at those seasons there is a great increase in insect life and the trees bear their fruit.

It is because of this great demand for food which takes place when the young emerge from the egg that in every country the birds nest at the season when the food of the description on which they feed their young is most plentiful.

A familiar illustration of this is afforded by the different times at which the crows and ravens nest in the British Isles. The ravens breed early in the year when the storms of winter provide plenty of dead sheep, while the crows that inhabit the moor wait until March or April when the sheep produce lambs and the grouse and lapwings nest.

In India the majority of birds breed in the spring when insects and fruit become abundant, but water birds wait until the advent of the monsoon, when the lakes become full.

A late monsoon retards the breeding operations of all the latter class of birds, and, in parts of the country where the monsoon fails, these birds either do not nest at all or migrate in search of some more favoured locality.

H. Terry records (*N. and E.*, III. 23) that several pairs of the Indian swift (*Cypsellus affinis*) began to build in the verandah of his bungalow in June, 1877. It had been raining for a day or two, the rain then suddenly ceased. The birds left off building and disappeared. There was no more heavy rain until the end of the following month, when the swifts (presumably the same ones) returned, completed the original nests and reared their young.

Despite the absence of the winter visitors and the increased food supply in the spring and rainy season there is not, even in the most favourable years, sufficient food to meet the needs of the adult population of birds and their young. As a consequence of this insufficiency, most, if not all, of those birds, which feed their young on insects found on the ground, the foliage and the bark of trees, mark out breeding areas, which they guard most jealously against all intruders of their own species. This matter has been carefully worked out in the case of English birds by A. Eliot Howard, who has recorded some of his observations in a most interesting book entitled *Territory in Bird Life.*

The species chiefly studied by Howard are reed-buntings, chiff-chaffs, reed-warblers, whitethroats, yellow buntings, guillemots, lapwings, cuckoos, marsh-warblers, wood-warblers, ruffs, coots and moorhens. At the beginning of the nesting season each male figuratively marks out, or tries to mark out, an area in which he resents the intrusion of any other male of his own species, and of any female after he has

mated. He and his mate attack viciously any other member of the species which comes into the area. Howard believes (and his belief is almost certainly justified by facts) that the size of the territory laid claim to by a bird is regulated by the amount of food supply required for the young. If the food supply be abundant, as in the case of the guillemot, the birds will nest almost touching one another; in that case the paucity of nesting sites causes this to happen. If food be scarce, the territory demanded by each pair of birds is large. According to Howard in the case of yellow buntings over an acre is required.

Such contests as those described by Howard take place in India. On July 14th, 1921, I witnessed a fight that took place in the grounds of the Aitcheson College at Lahore between two male golden-backed woodpeckers (*Brachypternus aurantius*). I first noticed one of these pursuing the other in the air. The pursued bird alighted on the trunk of a tree and his adversary immediately took up a position on the other side of the trunk at the same level, then both proceeded to work their way up the trunk, while so doing they came face to face two or three times and at each meeting pecked at one another. After a little the pursued bird (which I took to be an intruder on the sphere of influence of the other) flew to another tree and was promptly followed by his opponent. Thus they went from tree to tree, each time alighting on the trunk. Then the intruder flew to a branch and was followed by the other, who perched on another branch of the same tree. By this time both birds were

panting as the result of their vigorous movements. After remaining thus for a few seconds one of them began to call. Then they both took to their wings and met in mid-air, where they fought bill to bill. So far as I could see neither bird damaged the other. Then they broke away and one alighted on the trunk of a tree, while the other settled on a branch of the same tree. Each remained thus for fully ten minutes, bills open wide and panting as though exhausted. Then the bird on the trunk began to call, the other did not reply. A few minutes later the bird on the trunk flew away, and I saw him no more. The victor remained perched on his branch for some time, and then began to feed in the normal manner, passing from trunk to trunk. I am convinced that one of the woodpeckers had invaded the breeding territory of the other and was given no rest by the holder of the area so long as he remained there.

This necessity for breeding areas explains much, if not all, of the local migration that takes place in India. It is obvious that an area capable of supporting a population of adult birds may not be able to support them and their nestlings; thus at the nesting season many species have to extend their range and spread into an area where they would find it difficult to obtain food in winter.

This is very marked in the Punjab. In that province we find breeding in great numbers in the summer the following species which are not found there in winter: Oriole (*Oriolus kundoo*), purple sunbird (*Arachnecthra asiatica*), koel (*Eudynamis honorata*), yellow-throated

sparrow (*Gymnorhis flavicollis*), common and blue-tailed bee-eaters (*Merops viridis* and *philippinus*), red turtle dove (*Œnopopelia tranqebarica*).

Even with all this extension of range, it would seem that there is not sufficient nesting room, in consequence a great many birds do not nest every year.

Some account of these unmated birds has been given in Chapter III.

It is my belief that the reason why most, if not all, of these birds do not mate and rear young is inability to find breeding areas, which in turn is due to lack of food; the fact being that the area in which the birds of these species breed does not afford sufficient food to meet the requirements of all the members of the species at a time when all have young to feed.

It may not be out of place to indicate here the importance of this matter of unmated birds in respect of the theory of natural selection. Suppose a given species of birds to number ten million at the beginning of the autumn, and suppose that one million of these are killed during the winter. Suppose now that the breeding area available suffices to allow of eight million birds to nest. At the beginning of the nesting season there are nine million birds, so that one million are not able to nest. The fact that one million lost their lives during the winter does not reduce by a single pair the number of nesting birds; indeed, it tends to increase it, since, in addition to the normal complement of nesting birds and their young, there

are only one million mouths to feed, whereas there would have been two million but for casualties during the winter. The effect of this million deaths on the breeding operations would appear to be to allow some 250,000 more birds to breed than would have been possible had there been no casualties during the winter.

Thus the death of an adult bird ordinarily does not mean the loss of potential young, and so is far less serious to the species than it would be if every bird nested every year.

The fact that a great many of the game birds which visit India every winter are shot and snared does not seem to reduce the numbers visiting India is, I think, accounted for by this phenomenon of unmated birds. Otherwise it would be difficult to explain why the numbers of teal (*Nettium crecca*) which visit India do not diminish and those of the ruddy sheldrake (*Casarca rutila*) do not increase. Hundreds of thousands of the former are shot and netted in India every winter, while the latter are very little shot, not being accounted good eating.

From the foregoing it is evident that the food supply of the birds of India depends largely on the nature of the annual monsoon, that a poor monsoon operates as a powerful check on the avian population.

H. D. Olivier and C. G. Nurse have recorded (*B.*, XIV. pp. 172, 387, 582) some invaluable observations on the effects on the game and water birds of Western India of the failure of successive monsoons.

These observations may be summarized as follows :

The year 1899–1900 was practically one of famine in Western India owing to the failure of the monsoon. Olivier records that practically no rain fell, both the *rabi* and the *kharif* crops failed and there was little grass or water anywhere.

In the year 1900–1901 the early rainfall was good, but the later rainfall was small and, in consequence, the rice crop failed.

In the year 1901–1902 the early rains were abundant, but the late ones failed; nevertheless, the *kharif* crops were good and there was plenty of grass, but the *rabi* crops were poor, because the majority of the tanks dried in November, after which very little irrigation was possible.

In the winter of 1899–1900 migrant ducks and geese were plentiful in Western India, but, their usual haunts being dried up, they resorted in numbers to the big rivers, where very heavy bags were made by sportsmen. The birds appeared to be very tame owing to weakness in consequence of the rivers yielding insufficient food. Olivier is of opinion that few of the ducks which were compelled to have recourse to the rivers for food were in a fit condition to undertake their long migratory journey in the spring, and he believes that few of them were able to reach their breeding grounds.

The snipe and quail had no feeding ground whatever in Western India, and Olivier thinks that those which did not pass on must have died of starvation in their dried-up haunts.

As regards the resident birds, Olivier states that

the egrets, herons, ibises, etc., did not breed at all, and many must have migrated to other parts of the country; their numbers in Gujerat diminished.

Olivier noticed no diminution in the numbers of partridges, sand-grouse and resident species of quail.

During the winter of 1900–1901 very few ducks were seen in Western India; those which did occur were chiefly pochards and pintails. Gadwalls, teals and shovellers, which in previous years had formed the bulk of the bags, were conspicuous by their absence.

Snipe came in numbers, but by the end of November very few were to be seen. The reason of this was, Olivier believes, that all their feeding grounds, other than the rice fields, were ruined.

Very few quail were observed.

The egrets, herons, ibises, etc., were less abundant than they had been in the previous year. On the other hand, rain-quail, partridges and sand-grouse were usually abundant during the monsoon of 1901 and bred freely.

In the early part of the winter of 1901–1902 ducks were fairly plentiful, but many of them departed as the *jhils* dried up in November. Olivier found snipe only in the river. "The few snipe I killed," he writes, "were in wretched condition and could not possibly have survived the northward journey to their breeding grounds."

A good number of quail were shot early in the cold weather, but these birds soon disappeared, despite the

fact that their feeding grounds offered plenty of food. Olivier believes that the quail seen were nearly all the resident rain-quail (*Coturnix coromandelica*), which later migrated according to their habit.

Migrant cranes occurred only in their hundreds where previously they had been observed "in their millions."

Egrets, herons and other resident waders were so scarce as to be, in the words of Olivier, "practically near extinction," but rain-quail, partridges and sand-grouse were more plentiful than ever. Olivier writes: "The season 1901–1902 has, I fancy, been about the best on record for all these, and also for hares, of which there have been everywhere seen far more than I can remember during the last twenty years or more. Sand-grouse have been in some places innumerable, and those who care to shoot them over water have been able to make enormous bags, and I never remember seeing so many large coveys of ordinary grey partridges. Curiously enough the francolin or painted partridges seem to have suffered."

As regards sand-grouse Nurse confirms Olivier's observations. He remarks on the great increase in numbers since 1896 of the common (*Pteroclurus exustus*) and the painted sand-grouse (*Pterocles fasciatius*), and states that in Western India these species were extraordinarily abundant in the year 1901.

Thus, as the result of the failure of the monsoon in Western India in 1899, the migrant duck, snipe and quail starved unless they were able to find new feeding grounds. As other parts of the country were more or

less affected by the failure of the monsoon, it can have been no easy matter for these birds to find other feeding grounds, and this is the reason why many of the duck were compelled to resort to the rivers. Of the duck that remained in the vicinity of their usual feeding grounds, some may have died of starvation, many of those which managed to obtain sufficient food to keep body and soul together became so emaciated and weak that they fell easy victims to birds of prey, and those which escaped this fate were so weak as to be unable to endure the long migratory flight to their breeding grounds. In other words, probably none of the duck which did not find new breeding grounds lived to rear up young in the following summer. Perhaps the majority of those which sought new feeding grounds did well enough to be able to reach their breeding grounds. Olivier suggests that such, on their return to India in the following autumn, went, not to their old feeding grounds where they had failed to find food the year before, but to the new ones. This would explain the paucity of duck in Western India during the season 1900–1901. The few ducks that were seen there were chiefly pochard and pintail. Olivier suggests that these, being addicted to large reedy lakes, contrived to hold out in Western India in 1899–1900 and, being strong fliers, managed to reach their breeding grounds.

In 1901–1902 ducks were fairly plentiful in Western India. The birds seen there were probably birds driven into that area by there not being sufficient food elsewhere to feed all the duck that visited India, the

mortality that occurred in 1899–1900 having been made good in the breeding seasons of 1900 and 1901.

As regards the migratory quail, it would seem that the mortality among them was so great that two breeding seasons did not suffice to replenish their numbers sufficiently to render it necessary for any of them to overflow into Gujerat. Olivier thinks that not one of the regular Gujerat stock survived the famine year 1899–1900.

As there were no feeding grounds for snipe in either of the seasons 1900–1901, 1901–1902, it is impossible to determine whether the absence of these birds in Western India was due to this or to the mortality that resulted from want of food in 1899–1900.

The migrant cranes seem to have suffered as severely as the quail.

The egrets, herons, ibises, etc., were unable to breed in Western India in 1899–1900 owing to want of food there, and most of them had to seek feeding grounds elsewhere. These cannot have yielded sufficient food to support these immigrants and enable the residents to breed. As the two following years were lean ones in Gujerat, it is not surprising that these birds became almost extinct in that part of India ; the lack of food had prevented so many from nesting that the young reared were not nearly sufficient to replace normal casualties in these species.

Between 1899 and 1902 the numbers of rain-quail, grey partridges and sand-grouse increased enormously, while those of the painted partridges diminished.

Olivier points out that the factors which led to the

increase of the former were: (1) The dry seasons were favourable to their nesting, in that none of the nests were destroyed by being flooded, as happens in years when the rainfall is heavy; (2) The paucity of rainfall resulted in much land being thrown out of cultivation, and the crops on some of the cultivated land were so poor that it was not worth while to reap them, thus these birds had plenty of cover, and what food there was was reserved for them and had not to be shared with a host of geese, duck and other birds, as is the case in normal years.

That the painted partridges diminished in numbers, while the grey partridges increased, is, I think, accounted for by the feeding habits of the young of the former. These must have tender shoots of grass. Writing of the closely allied black partridge, Stuart Baker says (*B.*, XVII. 203): "In North Cachar, where the birds are very common in the wonderful park-like lands in the north, practically every egg was laid in April, after the first light rain had brought on a fresh growth of grass on the burnt lands. In Northern Assam, Cachar, Sylhet, etc., the birds occasionally laid in the end of March, and more often in May, and then again in July. In the Eastern Duars and the foot-hills of Nepal, June and May seem to be the two months affected as breeding time, but in the higher ranges they once more revert to April. Everywhere the time is governed by the abundance of food; this in turn depends on the rainfall and the time of year the natives burn the grass."

Another factor which contributed to the increase

of the rain-quail, grey partridges and sand-grouse was the comparative scarcity of rapacious creatures in Western India and Gujerat as a consequence of the deficiency of food in 1900. Most of the predatory birds and beasts were compelled to leave the affected areas because of the exodus of many of the creatures upon which they prey. Writing of the country round about Deesa, Nurse says : " Jackals almost disappeared . . . a considerable number being doubtless killed and eaten by the Wagiris and other aboriginal tribes."

Olivier states that the absence of predatory birds and beasts in Gujerat was most noticeable. In consequence of this exodus of birds and beasts of prey the creatures in those areas on which they normally prey were comparatively immune from attack.

Olivier points out how the departure of the birds of prey resulted in a great increase in the numbers of jerboas (*Gerbellus hurrianæ*), hares and rats. These last must have levied toll on the eggs and young of the birds and thus put a check on their increase.

The effects of a poor monsoon on the fauna of a locality are not confined to the diminution of food to which it leads. Blewitt records (*N. and E.*, III. 133) that in 1868 great scarcity prevailed in the Hansi district and the vicinity owing to the failure of the rains. All the babul, ber and pipal trees were denuded of their foliage in order to feed the cattle. Probably, partly as a consequence of there being no cover for the nests, and partly owing to the scarcity of food, he was able to find in 1869 only two nests of the

tawny eagle (*Aquila vindhiana*) where he had in 1868 met with scores of nests. He says that this species almost entirely deserted the locality in 1869.

Another effect of a poor monsoon is greatly to impede the nesting operations of terns, skimmers, pratincoles and other species which lay on the islets that form during the cold weather in the beds of Indian rivers. These species lay their eggs on these islands in order to protect them from snakes, rats, lizards, foxes, jackals, etc., which feed upon them and prey on young birds. When the rainfall is poor the rivers do not rise to their normal monsoon height, and by the spring the water is so low that most of these islets become part of the mainland ; in such circumstances eggs laid on what are normally islands are exposed to the attacks of terrestrial creatures. The monsoon of 1920 was a poor one in the Punjab ; in consequence in 1921 there were no islets in the river Ravi, near Lahore, where normally there are dozens. As a result I found only two terns' nests there instead of the usual hundred or more. Nearly all the terns which had previously nested there had either failed to lay or had gone elsewhere to do so. Probably all the eggs of those that did lay there were destroyed.

The various checks to the growth of the avian population usually act most powerfully on the young. The failure of the monsoon certainly does. We have already noticed how it tends to prevent birds from breeding. The comparatively few young which are hatched in time of scarcity must suffer in consequence

of the shortage of food. No one seems to have investigated this matter in India, but there are records from other countries of the effect of an unfavourable season on nestlings.

H. Gray, writing of England, says (*B.N.*, August, 1911): "During the early part of this summer, in consequence of the dry weather, thousands of thrushes, blackbirds, etc., have died from starvation, the dry weather either destroying the slugs, worms, etc., or driving them into obscurity and beyond the reach of the parent birds. Snow in March and April caused great mortality."

The dry spell in June, 1925, affected some of the insectivorous birds in England. I picked up a young pied wagtail in my garden which had evidently died of starvation.

The summer of 1907 was an exceptionally bad one in England, the weather being cool, windy and rainy except for a fortnight in June. The effect of this weather on the summer migrants to England is thus described by P. F. M. Galloway (*A.M.*, June, 1908, p. 248): "The continuance of cold and absence of sunshine prevented the old birds from rearing all their young, for they could scarcely find sufficient live insect food to keep themselves upon, to say nothing of rearing a brood of young. I found several nests of tree-pipits, willow-wrens, and even tree-creepers; all the young died in their nests. I have no doubt that there were many more that I did not find, in the same state. On examining the birds I found the young were in a very poor condition from want of

food and had died from starvation. A few of the nests contained young of about four or five days old, but most of those found dead were young just showing their feathers. This is easily accounted for; while the nestlings were very small they did not require such a large quantity of food, but as they struggled on to the stage of feathering, the demand for food was greater, and, as this could not be found in sufficient quantity, the young had to go under. I also picked up several adult birds, lesser whitethroats and willow-wrens, which I had no difficulty in catching, as they were in a weak state, and, on examination, found them in a very weak and ill-nourished condition. Young wrynecks I found in two instances drowned in the holes of trees where they had been hatched, these being well feathered."

We have direct evidence that the failure of some of the species imported into New Zealand to establish themselves, was due to want of suitable food for their young.

This matter is discussed at length by C. H. Thomson in *The Naturalisation of Animals and Plants in New Zealand*. The turkey (*Meleagris gallipavo*), the peacock (*Pavo cristatus*) and several species of pheasant were introduced into that country. For a time these species flourished and multiplied; then they became less plentiful and eventually disappeared. M. Low considers (*loc. cit.*, p. 108) that "the disappearance of the turkeys and pheasants, after they had become common in the North Island, was due to the fact that the starlings and other introduced birds ate out their

food, especially the insect life on which the young were chiefly reared. The poults were lost in their efforts to struggle after their parents for food. It was noticed that the young broods became smaller and smaller, until at last they failed to be reared."

Similarly H. T. Travers (*loc. cit.*, p. 109) says that the turkeys introduced into the Nelson district became extinct "in consequence of the great increase of introduced birds: these destroyed the grasshoppers on which the young turkeys lived."

Thomson, speaking generally of the larger game birds introduced into New Zealand, writes: "It is not so much the hawks, ferrets, wekas and owls, as the smaller birds which are the real cause of the diminution and disappearance of the larger species. It is the eating out of the food supply, and chiefly of the insect life, which is the main food supply of the young birds."

A species of bird may be compared to a chain of which the young are the weakest link; the strength of the chain is that of the weakest link. If the young must have food of a particular kind, the species will perish if this be lacking, no matter how plentiful be the supply of food suited to the adults. In estimating the effect of the food supply of a locality on a species, we must bear in mind that many birds feed their young on food different from that which they themselves eat.

The birds introduced into New Zealand which have thrived the best are the starlings, mynas, sparrows, song thrushes, blackbirds, rooks, hedge-sparrows, white-

eyes and skylarks, the young of which are able to subsist on almost any kind of insect food.

P. T. O'Regan (*loc. cit.*, p. 157) thinks that starlings, blackbirds and thrushes are responsible for the diminution that has taken place in the numbers of the native pigeons in New Zealand, as they eat the berries of the pine trees, fuchsias and aristotelias on which the pigeons largely subsist.

B. Spencer points out the effect of "good" and "bad" years on the small mammals of Central Australia. Drought kills numbers of these, especially the immature individuals, and the few survivors reach maturity without attaining the dimensions of individuals reared under more favourable conditions. "If," he writes, "the drought be abnormally prolonged, then even the hardiest animals will suffer, and the fauna will be so reduced that it may take some time before increased fertility on the part of the survivors and the influx of immigrants from the broad belt of land enclosing the central region will make good the deficiency."

On adult birds shortage of food has three main effects: (1) It inhibits their nesting operations; (2) It causes the birds that nest to lay fewer eggs than they would do under normal conditions; (3) It renders them so weak that many fall easy victims to birds of prey and some even may die of starvation.

We have already noticed how a poor monsoon in India affects the nesting operations of birds.

As regards the effect of food supply on the sizes of egg clutches, I have not been able to obtain any

direct evidence that a bad monsoon tends to reduce the size of these.

B. Spencer, however, tells us that the small mouse-like marsupial (*Sminchopsis crassicaudata*), which normally produces ten young at a birth, has only four or five in seasons of scarcity.

There is, moreover, evidence to show that there is a connection between the monsoon in India and the number of eggs laid.

Ticehurst noticed that the white-cheeked bulbul of Sind (*Molpastes leucotis*), in addition to the brood in March and April, rears a second in September in years when the rainfall is abundant, and the same is doubtless true of other species of which some members have a second brood in the autumn.

That an increase of food supply should tend to increase the egg-laying capacity of birds and a shortage to diminish it, is what our knowledge of physiology would lead us to expect. However, as we have noticed, egg-laying is affected by stimuli other than the abundance of food supply. (See p. 47.)

We know that the size of the clutch varies with the species. The reasons for this variation form an interesting study.

The fact that those birds of prey that feed upon other birds, the catching of which involves hard labour, I believe, explains why the clutches of raptorial birds are almost always small.

The spotted eagles (*Aquila maculata* and *A. hastata*), the crested hawk-eagle (*Spiziaëtus cirrhatus*), the changeable hawk-eagle (*S. limnaëtus*) and the short-toed

eagle (*Circaëtus gallicus*) usually lay but one egg, and other species of eagle only two.

Now, but for the difficulty experienced in finding food for their young, it would be to the advantage of every species to lay at each sitting as many eggs as it can cover when incubating. There can, I think, be no doubt that the reason why fewer are laid is that it is not only useless, but a waste of energy, for a bird to lay numbers of eggs the products of which it is unable to feed. If a pair of birds which can find food sufficient only for themselves and one young one were to lay four eggs, three of the offspring would starve to death and the growth of the surviving chick would be retarded owing to lack of sufficient nourishment.

Game birds, the young of which are able to run about and pick up food when they emerge from the egg, lay larger clutches than those that have to bring to the nest all the food consumed by their offspring. Parasitic cuckoos lay in the season twenty eggs or more ; they are able to distribute the work of feeding among a number of foster-parents.

Birds (other than parasitic cuckoos, which are a law unto themselves) seem to lay at a sitting just so many eggs as will produce the maximum number of the young for which they are able to find food.

That hen birds of almost every species are able to lay more eggs than they usually do there is abundant evidence. Many species rear a second brood as soon as the members of the first are able to look after themselves. When a nest is robbed, or the eggs or

nestlings are destroyed, the hen almost invariably lays more eggs. It is obvious that by laying first a clutch of four or five and then a second clutch of the same size after the products of the first have left the nest, a bird spends some fourteen days more in incubation than it would were the whole eight or ten eggs laid at one sitting. The reason for this apparent waste of energy can, I think, be no other than the inability of the parent birds to find daily enough food to satisfy more than four or five nestlings, as the case may be, in addition to what they require for their own sustenance.

As a matter of fact, many species seem to lay at a sitting rather more eggs than the number of young for which they are able to find food, with the result that one or more of their young starve. In the case of most insectivorous birds four seems to be about the maximum number of young they are able to feed in the most favourable conditions; this, I believe, is why such birds rarely lay more than five in a clutch.

Whenever a smaller clutch than this is laid, there appears to be some peculiarity in the food required by the young which renders the laying of as many as five eggs useless. Thus, vultures lay one egg, or occasionally two. These birds have to fly to some carcase, tear the flesh from it in lumps, swallow these, fly to the nest, disgorge each morsel and force it into the maw of the nestling.

Pigeons and doves mostly lay but two eggs. They feed their young on pigeon's milk—a secretion from

the crop—which presumably is not produced in sufficient abundance to satisfy the hunger of more than two nestlings.

Sarus cranes (*Grus antigone*) usually lay two eggs, and of these more often than not only one hatches out. There are exceptions to this rule. Hume records (*N. and E.*, III. 373) that, as the result of the inspection of over one hundred nests, he found only two containing three eggs, and that he has occasionally seen three young birds in company with an old pair. It might be thought that a pair of big birds such as these which nest in the rains, when their food is most abundant, would find no difficulty in securing sustenance for four or five chicks. That this is not so is indicated by some observations recorded anonymously in the *Avicultural Magazine* for December, 1914. These relate to the demoiselle crane (*Anthropoides virgo*)—a winter visitor to India. The writer says: "Two eggs are usually laid, but there the matter ends in the case of the ordinary aviculturalist, or, if they yield young, the parents do not succeed in rearing these. The great crux in the rearing of young cranes in captivity is producing an adequate supply of insect life as food. No one who has not persevered time after time, in spite of many failures, can realize what an enormous amount of soft-bodied insects these young cranes require, and how indefatigably the parents work in hunting and searching all over the paddock in order that the nestlings may have a proper and sufficient supply of food. It appears absolutely necessary that the insects for feeding the young cranes

must have *soft bodies*, as I have repeatedly noticed the old birds, when given a large dish of meal worms, carefully pick out those that had just sloughed their hard coats for the nestlings, and eat the others themselves. This seems rather strange, for adult cranes will eat the hardest-coated beetles with the greatest enjoyment. . . . The young seem to be entirely dependent on the old birds for at least a fortnight. . . . If there be two nestlings, each parent 'attaches' itself exclusively to one nestling, devoting the whole of its attention to that one in particular. . . . The young seem to be entirely dependent on the old birds for at least a fortnight, and, until that period has elapsed, I have never seen them attempt to pick up anything for themselves; just after the second week the old cranes commence giving the young wheat grains, and once they have succeeded in getting well on to this they will thrive well."

Similarly R. Cosgrave writes of the white-necked crane (*Grus leucauchuin*) (*A.M.*, March, 1911, p. 148): "When the second bird is strong enough to leave the nest the mother takes charge of it, and both parents work hard from dawn till about 8 p.m. searching every inch of ground for grubs and insects of all kinds."

In some cases, the smallness of the clutch may be due to causes other than difficulty of obtaining food for a large brood. Thus the fact that sunbirds (*Arachnechthra*) lay but two eggs in about nine cases out of ten (three being the complement in the tenth case), seems to be due to the fact that the pendent nest is

attached to its support by means of cobweb and the materials of the nest are held together chiefly by the same material. Although cobweb is remarkably strong it is my belief that there would be great risk of the frail structure giving way under the weight of a parent bird and three well-developed nestlings.

It is obviously to the advantage of a species that each hen should lay at a sitting up to what I may perhaps term the maximum feeding capacity of the parents; and this appears to be done, if we may judge by the industry of parent birds when there are young in the nest.

W. E. Collinge records (*Journal of the Board of Agriculture*, September, 1912) some interesting observations on the number of visits paid by parent birds to the nest with food. In the case of the starling (*Sturnus vulgaris*) on an average 32·2 visits per hour were paid between 4 a.m. and noon; then they became less frequent for a time, between 12.30 p.m. and 2.30 p.m. only about twenty-five visits were made. From 2.30 p.m. to 6 p.m. the number of visits averaged twenty-six an hour, when the frequency gradually diminished, and they ceased to bring food at 7.30 p.m. Thus in one day the parents were observed to bring food to the nest between 350 and 400 times. Collinge calculated that the house sparrow (*Passer domesticus*) in England brings food to the nest from 220–260 times a day. My observations of this species in India show that the parents on one occasion brought food to the nest eight times in fifteen minutes. In *Birds of the Plains* (p. 18) I wrote, as the result of

my observations, the hen sparrow feeds the young " at least fifteen times in the hour, and works for not less than twelve hours in the day. I timed the sparrow in question to begin feeding operations at 5.30 a.m., and when I left the bungalow at 6 p.m. the birds were still at it."

My observations revealed that in the case of that particular pair of sparrows the hen did by far the greater part of the feeding, that she visited the nest seven or eight times to one of the cock. The cock must have brought food to the nest at least thirty times in the course of the day. This would bring the number of visits of the two birds to from 240–270, which closely approximates to the 220–260 recorded by Collinge.

At each visit to the nest the parent brings more than one caterpillar or insect. Thus the number of insects carried to the nest daily cannot be less than 600; it is probably greater. In addition to finding these the parents have to obtain food for themselves.

As has been remarked, it is for the benefit of the species (as apart from the particular individual) that hens should lay up to the maximum food-finding capacity of the parents. Thus natural selection would tend to the development of hens that lay to this extent. In favourable seasons the parents may be able to find sufficient food to meet the wants of all their young. In unfavourable ones there will be a shortage of food for the young. It would be fatal to the species if the parents were to starve themselves in their efforts to satisfy their young; so that when

there is some shortage it is the young and not the parents that suffer. If all the young were treated equally by the parents they would either die in the nest or emerge from it in so weak a state as to fall easy victims to enemies. This does not happen ; when there is a shortage of food some of the young are starved to death while the others are well fed.

Very little attention appears to have been paid to this matter of feeding the young in the nest.

I am inclined to think that further observation will show that it is the exception rather than the rule for all the young in a brood to be adequately fed.

Although hoopoes (*Upupa indica*) have nested in or about almost every bungalow I occupied when residing in the plains of India, it was not until I had been fifteen years in the country that I ever saw more than one fully fledged youngster being fed by the parents. As five is the number of eggs usually laid, four out of five eggs seem to fail to yield young that live to fly.

Similarly I have usually seen but one young bulbul (*Molpastes*) following the parent bird. The same applies to the sarus crane (*Grus antigone*).

As it is unlikely that all save one of the eggs of each clutch laid by the birds in question were destroyed or became addled, it would seem that many of the young died of starvation.

Almost every aviculturalist has had occasion to notice what appears to be the neglect of one or more of their young by parent birds.

Let me here cite four instances taken at random.

Lord Poltimore (*B.N.*, October, 1911) states that a pair of guira cuckoos in his aviary laid eggs from which two young were hatched. One of these always kept ahead of the other, and the parents did not attend to the latter or appear to care for it. The backward bird disappeared when it was about three weeks old.

M. Amsler (*B.N.*, August, 1913) records that a pair of great tits (*Parus major*) in his aviary hatched out six young, of which five left the nest, the sixth dying.

Mrs. A. Mahon (*B.N.*, February, 1911, p. 51) states that three young bulbuls (*Otocompsa*) were hatched in her aviary and on the third day a dead nestling was thrown out of the nest.

E. Sprankling records (*B.N.*, December, 1911, p. 352) that four young goldfinches (*Carduelis*) were hatched, two of which almost immediately disappeared. "Where they went," he writes, "goodness only knows! The remaining two were fully reared, the old birds feeding splendidly."

As regards birds in the wild state R. M. Betham writes: "From observations extending over many years, I have, more or less, formed the opinion that the majority of birds rarely rear the same number of young as eggs laid." This observer records (*B.*, XII. 688) that a pair of white-eyes (*Zosterops palpebrosa*) had a nest in his verandah and laid in it four eggs, each of which yielded a chick, but only two of the latter lived to leave the nest. Two were much stronger

than the others and they received nearly all the food and attention of the parents. Twice a young one which had been ousted was replaced in the nest, but the parents, unlike human parents, seemed fonder of the stronger ones, who always shoved the weaker ones aside and got fed . . . when the strong ones were nearly fully fledged and ready to fly the weak were almost devoid of covering. . . . I have often noticed that birds laying four or five eggs are rarely followed by more than two or three young, and I believe that the weak nearly always go to the wall and that accounts for it. Betham, moreover, points out that the nest of the white-eye is not large enough to hold four fully grown young birds; thus, in the case of the white-eye at any rate, it would seem that nature invariably arranges that more young are hatched than the nest can hold.

B. B. Osmaston describes (*B.*, XXVIII. 1138) how a pair of golden-backed woodpeckers (*Brachypternus aurantius*) bred in a nest-box in his garden at Pachmari. Three eggs were laid, all of which had yielded young by March 20th. On March 22nd he noticed that one nestling was only half the size of either of the others. On the 26th he found only two young birds in the nest; the small one must have died from want of food and been removed from the nest. The other two nestlings left the nest on April 9th.

Many years ago, Theobald recorded that whenever he found two nestlings in the nest of a purple-rumped sunbird (*Arachnechthra zeylonica*) one was a little bigger than the other. He took the smaller one to

be a female. More probably, the difference in size is due to the fact that the older one receives more food than the younger.

B. Aitken writes of this species (*N. and E.*, II. 266): "On the 25th March, 1871, I found a nest at Poona which contained a young bird that I judged to be three days old and an egg ready to be hatched. I am surprised that no one seems to have noticed that one of the two eggs is nearly always addled. According to my experience both eggs are seldom hatched. I have found old deserted nests with a dried-up egg in them. I have found one young bird and one addled egg together, and I have never seen more than a single young one following the parent bird; but, excluding the case just mentioned, I have found only one nest with two young ones in it, and that was at Bombay in 1859—the young birds were fully feathered and almost ready to fly."

The lammergeyer (*Gypaëtus barbatus*) lays two or three eggs, nevertheless R. Thompson writes (*N. and E.*, III. 129): "I have frequently noticed parent birds with a single young one following them, and I am inclined to think that they seldom rear more."

Butler records (*N. and E.*, II. 241) finding a nest of the finch-lark (*Ammomanes phœnicura*) containing a single young bird ready to leave the nest. This species usually lays three or four eggs.

On one occasion I discovered in a nest, from which the young had just flown, a dead grey hornbill (*Lophoceros birostris*) nestling, which was just a bundle of feathers, skin and bone.

Magrath writes (*B.*, XVIII. 293) of the little Kashmir house-martin (*Chelidon kashmiriensis*) : " Seldom more than three eggs are hatched, and indeed three young pretty well fill the nest when half-fledged. As a rule there is never room for more than two heads at a time at the aperture of the nest to receive food, consequently one young bird is generally in the background and unable to procure sustenance until one or other of those at the entrance return satisfied. The parents appear to use no discrimination in their feeding, and it is a case of 'survival of the fittest,' the most vigorous securing most food."

Magrath's conclusions are perhaps questionable. As the eggs are not all laid on the same day, the chick which emerges from the last-laid egg is handicapped by the fact that its brethren all emerge before it does, and so are bigger, quite apart from any greater natural vigour he or they may have.

Again, the evidence, so far as it goes, tends to show that the parents do exercise discrimination when feeding, and this is usually in favour of the biggest, or at any rate the most pushing of the nestlings.

Thus, Burnett records (*B.*, XVII.) that the common wren-warbler (*Prinia socialis*), in the nest of which a plaintive cuckoo (*Coccomantis passerinus*) has laid an egg, turns out its own offspring in order to make room for the young cuckoo. He writes that, finding the young wren-warbler nestlings on the ground, he put them back three or four times, but it was no good ; they were regularly turned out again.

From the foregoing it appears that, in all but the

most favourable seasons, numbers of nestlings die of starvation, because more are hatched than the parents are able to feed adequately. Moreover, the ones that thus perish are not necessarily the least fit, but those that are handicapped by being the last to emerge from the egg.

The effect of food shortage on the adult individuals is so obvious that there is no need to dilate upon it. The adults soon begin to feel the effect of food shortage and grow weak, and so fall an easy victim to some rapacious creature. Some may die of starvation, but probably by far the greater number are seized by birds of prey some time before life would become extinct by reason of want of food.

As regards birds of prey which suffer from lack of food, I can find no evidence that the strong prey on the sickly individuals. These latter may generally die of starvation. The fact that so few dead birds are seen is probably due to the attentions of those birds and beasts that feed upon carrion.

As birds of prey have to work hard for their livelihood, they need to be in the pink of condition. When the ordinary food of a bird of prey becomes scarce it has either to seek new feeding grounds or to resort to other kinds of food. This is very noticeable in the case of the peregrine falcon (*Falco peregrinus*) in India, which feeds largely on ducks. It migrates from India with these. If during the day it has failed to find a duck, it has to resort to a place where the crows (*Corvus splendens*) congregate in their thousands to roost and seize one of them for its supper. We

may regard crows as starvation diet for a peregrine falcon.

When the quarry of any species of bird of prey becomes scarce, its numbers in that locality diminish. According to C. H. Donald (*B.*, XXVII. 34) the goshawk (*Astur palumbarius*) is becoming less abundant in the Himalayas than it used to be. He attributes this to the decrease in the numbers of pheasants on which it largely preys. When the natural quarry diminishes, a bird of prey has to turn its attention to other quarry; if it does not thrive on this, it becomes weaker and so finds difficulty in catching victims, does not breed owing to its want of vigour, and eventually starves to death, or perhaps falls a victim to some other bird of prey. C. H. Donald (*loc. cit.*) relates a most interesting experience he had with a goshawk. He was camping in the Himalayas late in November. "I was," he writes, "working in the verandah of the tent, which was enclosed by 'chicks'* all round, except the centre 'chick' which was tied up and acted as a doorway. Suddenly there was a tremendous commotion among the fowls and one old cock came rushing into the verandah with something hanging on to him, rushed past my table and into the tent itself. I followed and pulled the squalling bird out from under the bed, and to my surprise found a very ancient male goshawk, still holding on. I naturally thought it must be somebody's tame bird escaped. The hawk literally fell off the cock as I pulled the latter out from under the bed, and lay on the floor

* Blinds, made of split bamboo, to keep out insects but let in air.

in a sort of fit. I picked him up and found him emaciated to a degree and nothing but skin and bone. There was a slight wound in one wing, which accounted for his condition, and the poor thing evidently put in every ounce of his remaining strength to get a meal, but the cock was one too much for him in his starving condition."

VI. INSTINCT AT FAULT

WE have noticed (p. 79) that parent birds often permit some of their young to starve in the nest, and (see p. 83) that sometimes, at any rate, they may exercise no intelligence in feeding their offspring. Birds that are victimized by cuckoos take no notice of their dying chicks lying on the ground below the nest, while they feed the intruder most assiduously. One species—the common wren-warbler (*Prinia socialis*)—actually turns its own young out of the nest in order to give the baby cuckoo plenty of room!

Every year thousands of eggs and nestlings perish owing to acts which we should characterize as stupidity or vice if they were those of human beings.

At the nest birds appear to be guided almost entirely by instinct; their acts are then largely mechanical. In consequence, when a pair of nesting birds finds itself confronted with an unusual circumstance, such as a cuckoo's egg being deposited in the nest, they behave in a manner injurious to the preservation of their species. Thus, the Indian house crow (*Corvus splendens*), which normally seeks out and devours the eggs of other birds, will incubate in its own nest a koel's egg, or even a fowl's egg or a golf

ball. I myself have caused the crow to sit for days on both these objects. The fowl's egg was actually hatched out, but when the chick began to run about in the nest, the crows killed it. This incident shows that birds at the nest are not *purely* automata.

A broody barndoor hen will sometimes try to incubate a turnip. D. D. Cunningham records (*Some Indian Friends and Acquaintances*, p. 13) that "a kite (*Milvus govinda*) sat patiently for many days in the vain hope of hatching out a pill-box that it had secured from a terraced roof overlooked by the rooms occupied by a hypochondriacal member of the United Service Club in Calcutta." Another observer (A. O. Hume, I believe) once observed a kite incubating a hare's skull which she or her spouse must have brought into the nest.

I use the expression "instinct at fault" to describe any act, which, if that of a human being, would be deemed stupid or vicious. Further, instinct may be said to be at fault whenever it causes a bird or beast to do any act prejudicial to the welfare of the species.

Every aviculturalist and most observers of birds in their natural state must have come across cases of instinct at fault.

The conditions under which birds live in captivity are not normal and this doubtless sometimes leads to the perversion of natural instincts, but the cases of birds in captivity entirely neglecting their young and even devouring them or doing other acts harmful to the race are so numerous that it would probably not

be correct to attribute all such acts to the effect of the unnatural conditions in which the birds in question live. However, it is not necessary to mention any of these examples of instinct at fault, because it is easy to quote examples furnished by birds in their natural surroundings.

The more common cases of instinct at fault may be thus classified :

1. The desertion by parents of nests which contain eggs or young.
2. Their permitting one or more of the young to starve.
3. Failure of the parent birds to take proper care of the young after they have left the nest and before they are able to fend for themselves.
4. The choosing of unsuitable sites for nests and the construction of defective nests.
5. The breaking, destroying or eating of the eggs or young.

With classes 1 and 2 we have already dealt. (See pp. 41 and 80.)

The failure of the parent birds to take proper care of the young after they have left the nest and before they are able to fend for themselves.

Very few instances of this have been recorded in the case of wild birds. The reason may be that the phenomenon is of very rare occurrence, but more probably it is because it is no easy matter to observe wild birds sufficiently closely to discover such lapses of instinct.

We know that ducks on our ornamental waters sometimes take their young so far from shore that these tire and get drowned.

M. Low (see p. 69) describes how in New Zealand young turkeys and pheasants have died in their efforts to struggle after their parents for food.

The selection of unsuitable sites for nests and the construction of defective nests.

Doves often build their mere apologies for nests in the most unsuitable places, with the result that the nursery comes to grief and the eggs or young perish.

As it is the rule rather than the exception for a pair of doves to build nests in situations where they can be seen from afar, it is surprising that the whole dove family has not become extinct. That this has not happened seems to be mainly due to the persistence with which doves build after their nests have been destroyed, and also because they seem able to lay eggs at all seasons of the year.

R. Thompson writes (*N. and E.*, II. 355) of the spotted dove (*Turtur suratensis*): "In the selection of sites for their nests, these birds show very little intelligence, suiting themselves to the first place they find handy, often amongst old furniture in the verandah of a house, cornices of old buildings, low hedges and bushes, or even the lopped trunk of an old tree, if a flat surface is left sufficient to place the nest on, and often in the most exposed situations, where the wretched birds are sure to pay the penalty of their imprudence."

J. R. Cripps says of these birds (*N. and E.*, II. 356): "It is a wonder how they ever rear any young ones, considering how low and exposed the nests generally are."

Miss Cockburn remarks: "Doves are very careless in the construction of their nests."

These general remarks may be supported by two concrete cases. On page 133 of *Birds of the Plains*, I have described how a pair of little brown doves (*T. cambayensis*) built a nest on top of a *chik*, which, together with some sacking attached to it, presented a surface of about half an inch broad. On this precarious site the birds managed to raise more than one brood, but on one occasion one youngster and on another, two, fell out of the dangerous nest and were killed by the fall.

A. Anderson gives an account (*N. and E.*, II. 352) of the attempts of a pair of these doves to construct a nest in his tent: "The nest, if such it can be called, was placed close to the fringe of the *kunnaut* (wall of the tent), on one of the corner ropes, where it is double for some six inches and there knotted. The double portion was just broad enough, being three inches apart, to support the nest with careful balance: the *knot* acted as a sort of *buffer*, and prevented the twigs from sliding off, which most assuredly would have otherwise been the case, for the rope just there was at an angle of 45°. My tent had to be struck before the eggs were laid."

Greene records in his *Notes on Cage Birds* that a pair of bronze-winged doves (*Chalcophaps indica*) lost

two out of five young by these falling out of the nest.

Miss R. Alderson, writing of the same species (*A.M.*, March, 1914, p. 151), says: "Many eggs were laid, most of them were hatched, but, whether the young birds were more restless than most of their tribe I do not know; several were lost by straying to the nest side and getting caught in the nesting material or branches and dying before they could be rescued."

Mynas (*Acridotheres tristis*) are almost as careless as doves in the selection of nesting sites. I find in my notes records of an egg of this species falling out of a nest on top of a rafter in the verandah of the bungalow I occupied at Fyzabad, two nestlings tumbling out of a nest in my verandah at Almora, and the same number of young birds falling out of a nest under the eaves of the golf club-house at Lahore.

G. A. Pinto described to me how four myna nestlings were drowned by falling into a tank from a nest precariously situated in a bougainvillea creeper growing over his house at Lahore.

Three nestling sparrows (*Passer domesticus*) fell out of a nest in the pantry of my house at Lahore.

Magrath writes of Hodgson's striated swallow (*Hirundo nepalensis*) (*B.*, XVIII. 294): "The situation of the nests, or rather the remains of nests I saw, all appeared stupidly selected, being terribly exposed to wind and weather, and the nests had all collapsed."

Of the tailor-bird (*Orthotomus sutorius*) D. D. Cunningham writes, in *Some Indian Friends and Acquaintances*: "In most cases the leaves used in the

construction of the nest are of strong, rough texture, such as those of the common blue *Petræa* or of *Ficus hispida ;* but now and then a foolish pair of birds will attempt to make use of other kinds of leaves of which the texture is not capable of resisting the strain of the stitches, so that the thread gradually cuts its way through the leaves and leaves the blades gaping. Disasters of this kind often take place when the leaves of the common white *Ixora* have been used, and half-finished and deserted nests are therefore often to be met with in the shrubs."

At Lahore scores of the nests and eggs or young of the ashy wren-warbler (*Prinia socialis*) are destroyed every spring by the cutting of the wheat crops, among which they are built.

The breaking or destroying or eating of the eggs or young.

Few cases of this form of defective instinct among birds in their natural state are on record. This may be because such lapses of instinct are likely to be discovered only by accident.

A. G. Butler records (*British Birds with their Nests and Eggs*, I. 20) how a wild blackbird in England watched each morning until its mate had laid an egg, and then devoured this.

A. O. Hume (*N. and E.*, III. 189) stated that when he shot the male of a pair of nesting lugger falcons (*Falco jugger*) the female " turned towards the inside of the nest, gave a vicious dive at it with her bill and flew off. On taking the eggs it appeared that she had driven her powerful bill into one of them, making

a triangular hole, each side of which measured about ½ inch."

A. Anderson records (*N. and E.*, III. 193) that when he sent his man up a tree to the nest of a red-headed merlin (*Falco chicquera*) the nest was found to contain two fresh eggs, "but one of them had a largish hole on one side, exactly like what would be made by the beak of a bird"; through this aperture he blew the specimen.

W. Theobald says (*N. and E.*, III., 206) that after he had robbed a pair of Indian white-backed vultures (*Pseudogyps bengalensis*) of their egg, the female, on her return, "tore the upper part of the nest to pieces."

Aviculturalists very frequently notice lapses of instinct of the class with which we are now dealing.

C. E. Rattigan records (*A.M.*, February, 1911, p. 118) how a cock spotted-backed weaver (*Hyphautornis spilonotus*) three times pulled down his mate's nest. After one of these escapades Rattigan found a young bird lying dead among the ruins.

A. G. Butler relates (*A.M.*, March, 1905, p. 153) how a hen *Garrulax sinensis* in captivity ate her own egg after brooding it for some time. He attributed this to high feeding.

Russ (*A.M.*, April, 1905, p. 198) records the destruction by a hemipode (*Turnix nigricollis*) in captivity of a nest containing eight eggs. A new nest was made in the same place and eight eggs laid; six of these were neglected, but two chicks were hatched.

The male swan sometimes, at any rate, kills his

own offspring if left in the same pond with them in autumn.

R. Suggitt writes (*B.N.*, February, 1915) of a pair of guans (*Ortalis vetula*) that bred in his aviary, "for some reason the cock became greatly excited soon after the young were hatched, and threw two of them into the air. I don't suppose he really intended to injure them, as he was afterwards calling to them with food in his beak, but one of the young ones was found dead the next morning, and I attribute its death to his rough treatment."

VII. DESTRUCTIVE AGENCIES

A. ENEMIES

BIRDS

IT is obvious that we are not in a position to understand the nature of the struggle for existence of birds in India until we have taken stock of their enemies and of the various inanimate destructive agencies against which they have to contend.

Let us therefore notice some of the chief enemies of birds.

(i) BIRDS OF PREY

The birds of prey are certainly a powerful check to the growth of the non-raptorial avian population, but, owing to the dramatic manner in which they capture their quarry, I am inclined to think that the tendency is to overestimate the amount of destruction they cause. This destruction is great, particularly in the case of certain members of the family. We must, however, not forget that the raptores confine their attentions almost entirely to birds which have left the nest; for this reason I am inclined to think that, as regards India, the damage caused by all the raptores

together is less than that wrought by the crows and tree-pies, which prey chiefly on eggs and nestlings, for which they search in a systematic manner. The number of crows in India is certainly greater than that of all the kinds of raptorial birds which habitually prey upon other birds.

Some raptores rarely, if ever, attack other birds; some do so only occasionally, while others prey largely on small birds. It is, of course, these last which operate as a powerful check on the growth of the avian population.

Thus, for our purposes, the raptores fall into three classes: those which habitually, those which only occasionally, and those which never prey upon other birds. It is easy enough to state that these three classes exist, but a far more difficult matter, in the present state of our knowledge, to place each bird of prey in its proper class.

It is with some diffidence that I classify the raptores of India as follows:

THOSE THAT PREY LARGELY ON OTHER BIRDS

Goshawk—*Astur palambarius.*
Hodgson's Hawk-Eagle—*Spizaëtus nepalensis.*
Peregrine Falcon—*Falco peregrinus.*
*Shahin Falcon—*F. peregrinator.*
Laggar Falcon—*F. jugger.*
*Barbary Falcon—*F. barbarus.*
Bonelli's Eagle—*Hieraëtus fasciatus.*

*=Uncommon.

Booted Eagle—*H. pennatus.*
Crested Hawk-Eagle—*Spizaëtus cirrhatus.*
Changeable Hawk-Eagle—*S. limnaëtus.*
Legge's Hawk-Eagle—*S. kelaarti.*
**Rufous-bellied Hawk-Eagle—*Lophotriorchis kieneri.*
Black-Eagle—*Ictinaëtus malayensis.*
Sparrow Hawk—*Accipiter nisus.*
*Besra Sparrow Hawk—*A. virgatus.*
Shikra—*Astur badius.*
*Crested Goshawk—*Lophospizias trivirgatus.*
Merlin—*Æsalon regulus.*
Red-headed Merlin—*Æ. chicquera.*
*White-legged Falconet—*Microhierax melanoleucus.*
**Red-legged Falconet—*M. entolmus.*

THOSE THAT TAKE OTHER BIRDS ONLY OCCASIONALLY

Tawny Eagle—*Aquila vindhiana.*
Golden Eagle—*A. chrysaëtus.*
Imperial Eagle—*A. heliaca.*
Steppe Eagle—*A. bifasciata.*
Large Spotted Eagle—*A. maculata.*
Small Indian Spotted Eagle—*A. hastata.*
Crested Serpent Eagle—*Spilornis cheela.*
Pallas's Fishing Eagle—*Haliaëtus leucoryphus.*
White-bellied Sea-Eagle—*H. leucogaster.*
Brahminy Kite—*Haliastur indus.*
Common Pariah Kite—*Milvus govinda.*
Pale Harrier—*Circus macrurus.*

*=Uncommon. **=Very uncommon.

Montagu's Harrier—*C. cineraceus.*
Hen Harrier—*C. cyaneus.*
Pied Harrier—*C. melanoleucus.*
Marsh Harrier—*C. æruginosus.*
Long-legged Buzzard—*Buteo forox.*
Common Buzzard—*B. desertorum.*
Crested Honey Buzzard—*Pernis cristatus.*
Saker Falcon—*Falco cherrug.*
Hobby—*F. subbuteo.*
Indian Hobby—*F. severus.*
Eastern Red-legged Falcon—*Erythropus amurensis.*
Kestrel—*Tinnunculus alaudarius.*

Thus, there are in India some twenty-one species of raptores which feed largely on other birds and twenty-four which do so occasionally.

To the latter the white-eyed buzzard (*Butastur teesa*) should perhaps be added, because the remains of birds have been found in the stomach of this species. These remains, however, were almost certainly those of wounded or sickly birds, or possibly birds found dead. I have never seen this species take a live bird. A pair that reared a brood at Lahore in 1921 appeared to feed their young entirely on frogs at first, and later on lizards. The fact that small birds show no signs of alarm on the appearance of this species is a sure sign that it rarely, if ever, captures them.

In order to endeavour to ascertain the extent to which birds of prey operate as a check on the growth

of the avian population, it is necessary to consider in some detail the habits and distribution of each species that takes birds.

The Goshawk

This bird is, for all practical purposes, confined to the Himalayas. In very severe winters stragglers may visit the plains. Thus, the goshawk operates as a check only in the Himalayas, so far as India is concerned. It feeds chiefly on pheasants, partridges, other game birds and pigeons. It probably takes any kind of bird, also hares and even gazelles. Where it does occur it is a scourge to the game birds. C. H. Donald declares (*B.*, XXVII. 134) that this species and Hodgson's hawk-eagle do "more damage among game birds than perhaps all the other birds of prey combined." He is of opinion that the goshawk is diminishing in numbers in the Himalayas, and attributes this to the diminution in the quantity of small game.

Hodgson's Hawk-Eagle

This fine bird, like the goshawk, feeds largely on pheasants, other game birds, pigeons, poultry, hares and even deer. It also is a Himalayan bird; a few individuals visit the plains in winter. It operates as an appreciable check only in the Himalayas and, to a lesser degree, in the forests of Northern India. Except as regards game birds and pigeons, this species and the last appear to have little effect on the growth of the avian population of India.

Peregrine Falcon

This bird is a winter visitor to India, but it spreads itself all over the country and is fairly abundant. It feeds chiefly on ducks and waders. It also captures numbers of pigeons, pheasants and partridges and has been observed killing snipe and paroquets.

It is undoubtedly an appreciable check to the growth of the population of the migrant ducks and waders.

Shahin Falcon

This is a permanent resident. It subsists mainly on birds; pigeons, doves and paroquets being the chief items of its menu. It has also been seen to attack nightjars, mynas, thrushes, partridges and quail. It is not a common bird and hence does not operate as an important check on the bird population.

Laggar Falcon

This is a permanent resident, and, although found in most parts of India, is abundant only in the north-western part of the country. It subsists largely on quail and snipe in the winter. It is also very partial to pigeons, doves and rollers. W. Jesse (*Ibis*, 1902, p. 49) writes that at Lucknow it preys on the pigeons of the city.

A. Hume records (*N. and E.*, III. 189) coming upon a nest, the ground under which was strewn with feathers of pigeons, doves and rollers.

C. M. Inglis saw (*B.*, XIV. 560) a laggar falcon strike a drongo (*Dicrurus*) and devour it on the ground.

In the United Provinces and surrounding country this species undoubtedly checks the growth of the population of doves, pigeons, rollers, quail and snipe.

Barbary Falcon

This subsists on the same kind of birds as the laggar; as it is merely a winter visitor and only to the northern parts of India and comes in small numbers, it has little effect on the growth of the population of the species on which it preys.

Bonelli's Eagle

This fine bird is a permanent resident and occurs in most parts of India, but is common only in the Himalayas, N.W.F.P., Punjab, U.P. and Sind. It preys largely on ducks, partridges, peafowl, jungle-fowl, spurfowl, florican and pigeons. It does much damage to pigeon lofts and poultry yards. When it has not been able to secure a duck or a game bird it often resorts to the grove where the crows of the locality roost and seizes one of them. A. O. Hume records (*N. and E.*, III. 141) witnessing this bird capture a little brown dove (*Turtur cambayensis*). It undoubtedly checks the growth of the population of ducks and game birds in India.

Booted Eagle

This species occurs throughout India, but most members leave the country in the spring. It is destructive to doves, pigeons and poultry, nor does

it despise smaller quarry. Layard mentions (*J.*, I. 64) once having seen it pounce upon a bulbul in a bush. As it feeds largely on squirrels and rats and is not very common, it is not a powerful check to the avian population.

Crested Hawk-Eagle

This is a permanent resident; it affects mainly forest country and occurs chiefly in Central and South India. It preys upon partridges, young peafowl, jungle-fowl, quail and poultry. It has been seen to attack green pigeons and nightjars. Owing to its somewhat restricted distribution and the fact that it subsists largely on hares, squirrels and lizards, it is not of much account as a check to the growth of the bird population of India.

Changeable Hawk-Eagle

This bird often takes peafowl; indeed in Garhwal it is known as the *mohrkaita*—the peacock-killer. It has been seen to capture pigeons, chickens, mynas and the koel (*Eudynamis honorata*) (*B.*, XII. 685).

J. R. Cripps writes (*N. and E.*, III. 150) of a young bird in captivity: "He used to eat the flesh of every kind of bird except that of *Hierococcyx* (hawk-cuckoo), which he would always throw up. . . . He would not do this with owls' and hawks' flesh."

This species is confined to the forests of Bengal, Assam and Burma and the lower Himalayas.

Legge's Hawk-Eagle

This species feeds on the same kind of food as the last named. It is confined to the mountains of South India and Ceylon.

Black Eagle

This eagle feeds largely on the young and eggs of birds and was seen by Bourdillon to carry off nests and examine their contents (*F.*, III. 348). So destructive to game birds is it that a reward for its destruction is offered by the Nilgiri Game Association. Jerdon observed it feeding on the eggs of the hill quail (*Coturnix erythrorhyncha*), babblers and doves (*J.*, I. 66). It is said occasionally to carry off jungle fowl, but it is not sufficiently swift on the wing to capture pheasants or partridges. It doubtless often takes sickly birds. It is very destructive where it exists, but its range is restricted to hilly country.

Sparrow-Hawk

This bold little hawk is very destructive to small birds, which constitute the chief items of its diet. It is very partial to doves. It will take any bird up to the size of a pigeon. It shows little fear of man; H. Stevens saw a sparrow-hawk capture a sparrow in the verandah of a bungalow (*B.*, XXIII. 565).

It breeds in the Himalayas and is a winter visitor to the plains of India, over which it spreads itself, but it avoids dense forest and very open country.

Besra Sparrow-Hawk

Its food is similar to that of the sparrow-hawk; as it occurs only in forests it is almost negligible as a check on the population of small birds.

Shikra

This bird occurs in all parts of India except very high hills, dense forests and deserts. With the exception of the kite (*Milvus govinda*) it is the commonest bird of prey in India. It feeds largely on lizards, but small birds form a not inconsiderable portion of its food; this fact, coupled with its large numbers, results in its being perhaps the most destructive to small birds of all the raptores in India. In 1921, I had under observation a nest of a pair of shikras. Between April 25th and June 20th the parent birds or the young were seen to be feeding on lizards on four occasions, sparrows on six, once on a swallow and once on a hoopoe.

C. H. Donald writes of the shikra (*B.*, XXVII. 136): "This species must prey a good deal on the Indian babbler (*Crateropus canorus*), as every shikra is anxious to get at a babbler as soon as he hears them, but, easy though they must be to catch, the shikra has his work cut out to retain his quarry. The moment one is caught the remainder of the flock rush to the rescue of their 'sister,' with feathers fluffed out, wings drooping, and tail spread, the entire sisterhood come to the attack and the shikra is struck from every side

of the compass at one and the same time. I have had a tame shikra knocked clean over on his back and made to release his hold and seek shelter from the infuriated mob. If he can take his prey at once and fly across an open bit of country or get into very thick scrub, he is probably left in peace, but otherwise he finds it no easy matter to retain his meal."

C. M. Inglis (*B.*, XIV. 599) once saw a shikra turn on a king-crow (*Dicrurus ater*) which was chasing it. The shikra suddenly poised in mid-air and seized the king-crow as it passed.

The hoopoe and the babbler appear to be the largest birds commonly taken by the shikra, and sparrows form by far the greater part of its avian quarry. Each pair of shikras probably account for from twelve to twenty small birds every month.

Crested Goshawk

This species feeds on birds and lizards. H. Stevens (*B.*, XXIII. 565) saw a crested goshawk carrying a hill partridge (*Arboricola rufigularis*), which it dropped. The partridge had been picked almost bare.

The crested goshawk is confined to forest country and is not common, thus it does not operate to an appreciable extent as a check on the growth of the avian population.

Merlin

The merlin feeds mainly on small birds; it is very partial to sparrows and wagtails. It occurs in India only in winter and then only in the north-western

parts of the country, and is not sufficiently abundant to exert much influence on the population of small birds.

Red-headed Merlin

This, like the merlin, subsists largely on small birds. It is not afraid to tackle starlings, doves and pigeons. As it ranges over most of India and is fairly common it must check appreciably the growth of the population of larks, sparrows, wagtails and smaller plovers, to which it is very partial.

White-legged Falconet

This preys largely on small birds. H. Stevens (*B.*, XXIII. 565) saw this falconet with a sparrow in its talons on one occasion, and on another he witnessed it seize one of a number of swallows that were flying round a haystack.

Stuart Baker (*B.*, XI. 404) once saw it eating a scimitar babbler.

However, it is of local distribution and so is not of much importance as a check on the growth of the population of small birds in India.

Red-legged Falconet

This preys on small birds, but is rare and found only in the Himalayas, Assam and Burma.

The above completes the survey of the species which feed largely on birds. It will be observed that

these seem to confine themselves mainly to a few species. The larger ones feed chiefly on game birds, pigeons, doves, peafowl and poultry and the smaller ones on sparrows, larks, wagtails, babblers and doves. Other species are, of course, taken on occasions.

Let us now briefly notice the raptores that take birds occasionally, that is to say, those which feed mainly on other quarry, but seize birds whenever an opportunity occurs.

Tawny Eagle

This is the most abundant eagle in India. It is a permanent resident in all the drier parts of the country. If it habitually captured birds, it would be a very potent check on the growth of the avian population. Too sluggish in its movements to overtake other birds, it, however, often robs smaller raptores of their quarry and, as these have to replace that of which they have been robbed, the tawny eagle acts indirectly as a destructive agency.

Moreover, cases of this species killing other birds are on record. Jerdon states (*J.*, I. 61) that he once saw a pair of tawny eagles kill a florican. A. J. Currie relates (*B.*, XXIV. 571) how a pair attacked and killed a white stork.

H. Whistler (*B.N.*, January, 1915, p. 20) witnessed what he took to be a tawny eagle stoop on to a thorn bush, where it remained balancing itself on outstretched wings, while it pulled at something. He went to investigate and the eagle flew away with

empty talons. The only quarry he could find in the bush was a half-feathered young babbler. He thinks that when he saw the eagle it was devouring babbler nestlings.

On another occasion the same observer noticed (*B.N.*, July, 1914, p. 243) a pair of red-wattled lapwings (*Sarcogrammus indicus*) mobbing a tawny eagle, which was attacking their eggs. When Whistler reached the nest he found that all the eggs (three) had been broken into and their contents partly devoured.

Golden Eagle

The operations of the golden eagle in India are mainly confined to the Himalayas. It lives chiefly on mammals, but takes a number of pheasants and other game birds. According to Wilson (*H. and M.*, I. 269) the golden eagle is an inveterate annoyer of the Himalayan snow-cock, but never pursues it on the wing. It is also partial to pigeons. C. H. Donald records (*B.*, XXV. 634) that it kills many jungle crows (*Corvus macrorhynchus*).

Imperial Eagle

This is chiefly a winter visitor to India and keeps to the northern and central parts of the country. It is rather slow in its movements and subsists largely on carrion. It takes lizards and small mammals. Jerdon states (*J.*, I. 337) that it sometimes pounces on floricans, and Hume (*My Scrap Book*, p. 145)

says it eats quails and other birds. It has very little effect as a check on the avian population; as Hume observes (*loc. cit.*),"it is no better than a great hulking kite."

Steppe Eagle

This is a common winter visitor to the northern and central parts of India and to Burma. Like the imperial eagle it does little damage to birds.

Large Spotted Eagle

This lives chiefly on lizards and small animals and only on rare occasions takes birds. It is a slow-flying species.

Small Indian Spotted Eagle

This is another sluggish bird which rarely attacks other fowls. Firth, however, once saw it pulling down the nest of a pied myna (*Sturnopastor contra*) (*F.*, III. 342).

Crested Serpent Eagle

Blyth writes of this and other serpent eagles (*My Scrap Book*, p. 255) that they "subsist mainly on large frogs (which they clutch in the mud) and on the more or less aquatic snakes." Hume writes (*loc. cit.*): "All the specimens I obtained had eaten small snakes; there were fully fifty little serpents in the stomach of one, things scarcely bigger than large worms." Although snakes and frogs form its staple diet, it

attacks poultry, and Stuart Baker states (*B.*, XI. 400) that it takes jungle-fowl, pheasants and herons. It is of little account as a destroyer of birds.

Pallas's Fishing Eagle

This species is common in Northern India. It feeds chiefly on fish and waterfowl. It is undoubtedly destructive to coots and, to a less extent, to ducks. K. C. Macdonald records (*B.*, XVII. 495) once finding in the gullet of a nestling fully four inches of the tarsus of an egret. Hutton (*My Scrap Book*, p. 252) declares that this fishing eagle captures all kinds of game, hares and even young foxes. This, however, is not the experience of most observers. Pallas's fishing eagle certainly assists in keeping down the population of waterfowl.

White-bellied Sea-Eagle

This is far more piscivorous than the species just mentioned, and only rarely captures birds.

Brahminy Kite

This handsome bird subsists mainly on garbage, fish, frogs and crabs. It, however, raids poultry yards for the chickens. The remains of wild birds have on several occasions been observed in its stomach. Rainey saw (*F.*, III. 373) this species kill and eat a kingfisher (*Alcedo ispida*) that had seized a fish on which the

kite was in the act of stooping. It will attack wounded birds. It is not of much account as a check to the avian population.

Pariah Kite

The kite is by profession a scavenger. It is sometimes a nuisance to those who keep poultry. According to Phillips, it occasionally carries off a paroquet. Although it rarely attacks wild birds, it makes short work of those that are wounded or ailing.

A. P. Taylor, writing to the *Statesman* after a great storm in Culcutta, says that kites killed and ate many crows and sparrows that became disabled in the storm.

C. B. Ticehurst (*B.*, XXVIII. 799) charges this species with destroying many young birds and nestlings.

Pale Harrier

This, like other harriers, feeds chiefly on lizards, field mice and insects. It occasionally takes a lark or other small bird.

Montagu's Harrier

This may sometimes capture a small bird.

Hen Harrier

H. Stevens states his belief (*B.*, XXIII. 565) that the hen harrier preys on small birds much more than is commonly supposed. He writes: "Hoopoes fall an easy prey and pay a heavy toll in consequence."

Once he found lying on the ground feathers of a minivet (*Pericrocotus brevirostris*), bulbuls (*Otocompsa* and *Molpastes*) and a trogon (*Harpactes erythrocephalus*), which he thinks were victims of this species.

Pied Harrier

This harrier feeds chiefly on lizards, frogs, snakes, mice and insects. It only rarely captures birds.

Marsh Harrier

Writing of this species, W. Jesse says (*Ibis*, 1903, p. 77): "Teal and duck of all sorts they harry, and coots they drive into a perfect frenzy, though I have never seen them strike home."

They appear to capture only wounded or sickly birds, but are said to take eggs.

Probably the damage done to birds in India by all the harriers put together is small.

Long-legged Buzzard

This is generally supposed never to attack birds. H. Whistler, however, records (*B.N.*, April, 1914) finding the remains of a crow in the gizzard of this species, and mentions that one attacked a pigeon set as a bait for a peregrine falcon.

Common Buzzard

This buzzard occasionally takes sickly or young birds.

Crested Honey Buzzard

This species subsists chiefly on honey and bees, but it takes the young and eggs of small birds, and was once observed by C. M. Inglis to capture a black-headed oriole (*Oriolus melancocephalus*) (*B.*, XII. 758).

Saker Falcon

This bird feeds mainly on lizards, but occasionally takes a bird.

Hobby

This lives chiefly on insects, but sometimes devours birds. H. Whistler (*B.N.*, 1923, p. 137) witnessed one kill a sand-piper (*Tringa ochropus*).

Eastern Red-legged Falcon

Only rarely does this seem to capture birds.

Kestrel

The kestrel in England frequently takes small birds. I have never seen it do so in India, but Jerdon (*J.*, I. 39) states that it occasionally seizes young or sickly birds, and G. Reid once saw (*Ibis*, 1902, p. 566), at Lucknow, a kestrel feeding on a dove (*Turtur suratensis*).

The above survey indicates that of the twenty-six species which occasionally take birds, only some six

seem to have any appreciable effect as checks to the growth of the avian population of the country.

Of the twenty-one species that subsist largely on birds, seven are so uncommon that their effect can be but small. Thus, there are about twenty species which are checks of some importance. These twenty species do not all occur at the same time in any one locality. Some are merely winter visitors, others are confined to the hills, others to the plains, some keep to forests, several are of local distribution. We may take the country round about Lucknow as typical of the plains of India. W. Jesse published in the *Ibis* in 1902 and 1903 a list of the birds found in the districts of Lucknow, Barabanki and Unao, which cover an area of some 5000 square miles. This list includes ten of the raptores which habitually prey on other birds and sixteen of those which occasionally capture them. Of the former, four are so uncommon in the area in question as to be negligible. Of the sixteen which occasionally take birds, two are so rare as to be negligible. Of the fourteen that remain, nine are merely winter visitors to the locality.

There are, then, in that area twenty-two raptorial birds which prey, more or less, on other birds, and half these are but winter visitors. These have a choice of some 250 species of birds on which to prey.

Speaking generally, birds of prey subsist on species that are most abundant. Each species, so to speak, specializes on certain kinds of quarry.

Birds, such as flycatchers and barbets, which keep

to foliage, and those, such as nuthatches and woodpeckers, that spend their time on the trunks of trees, are rarely captured.

The only species which appear to suffer at all severely from the attacks of the raptores in India appear to be game birds of all descriptions, ducks, waders, pigeons, doves, starlings, larks, sparrows, wagtails, and, to a lesser extent, babblers, hoopoes, crows, bulbuls, rollers and paroquets.

Lizards, snakes and small mammals are easier to catch than birds, and have not to be plucked, and so are attacked far more than are birds.

New Zealand furnishes direct evidence of the comparative ineffectiveness of birds of prey as a check on the multiplication of the species on which they prey. Thomson (*The Naturalisation of Animals and Plants in New Zealand*, p. 162) points out that the white-eye (*Zosterops cærulescens*) has firmly established itself in that country despite the energetic measures adopted by man for its destruction and the fact that it is "more mercilessly attacked and destroyed by the large predatory birds than any other species, perhaps because it seems less suspicious of enemies than introduced finches or even small indigenous birds." He adds that white-eyes are frequently killed by hawks, kingfishers, long-tailed and shining cuckoos.

As regards India, we have noticed that several species of raptores prey almost entirely upon sparrows, doves and pigeons, yet these three kinds of birds are among the most numerous in India, and there is no indication that their numbers are tending to diminish.

Birds of prey are immune from attacks of raptores, yet few species are very abundant.

In the present state of our knowledge of the feeding habits of the various species of birds of prey, the numbers of these and those of the birds on which they prey, it is not possible to attempt to estimate with the slightest approach to accuracy the effectiveness of any species as a check to the growth of population of any kind of bird. No one has so far attempted to estimate the numbers of any species in any given area.

Were a census to be taken, it seems probable that few, if any, of the larger species of raptores would be found to average more than one pair to a square mile. In the case of the shikra the number may be something between four and eight to the square mile.

The population of some of the species on which they prey is, of course, far more dense. In certain urban areas there must be as many as 5000 crows to the square mile. I estimated (see p. 133) that the number of crows that roosted at Rajmundry was about 50,000. I do not know how extensive the feeding area of these is, but it is probably less than sixteen square miles.

The roosts of blue-rock pigeons (*Columba intermedia*) give us some idea of the abundance of this species in India. At Benares thousands of these birds roost on the roof of Queen's College. At nightfall the roof of that building is packed with pigeons. Not only the roof itself, but every ledge and cornice is covered

with these birds. Hume writes of this species (*N. and E.*, II. 344): "At the grand old fort of Dig, in Bhurtpore, where, as in most parts of Rajputana, they are sacred, and even a European who molested them would risk his life, several hundred thousand pairs must live and breed. A gun fired in the moat towards evening raises a dense cloud, obscuring utterly the waning day and deafening one with the mighty rushing sound of countless strong and rapidly plied pinions."

Jerdon (*J.*, III. 470) records that the falls of Gaissoppa are tenanted by thousands of these pigeons.

Paroquets, sparrows, mynas and night herons often roost together in large numbers; thus their roosts give some indication of the numbers of the birds that live in the locality.

In 1910 I came upon a small mango grove about two miles from Allahabad, a place where the rose-ringed paroquet (*Palæornis torquatus*) is not particularly common; nevertheless I counted more than five hundred individuals which had come to roost in that grove.

At Lahore, where paroquets are very abundant, most roosts are tenanted by upwards of a thousand paroquets.

As regards the common myna (*Acridotheres tristis*), D. D. Cunningham writes (*Some Indian Friends and Acquaintances*, p. 29): "During the latter part of the autumn and the whole of the cold weather, many of the gardens in the European part of Calcutta are nightly tenanted by countless multitudes of mynas,

who go out in the morning to the suburbs and the country around, and return to town again towards sundown. . . . The Residency at Katmandu (Nepal) lies on the brow of a slope overlooking a wide expanse of rice fields, on the farther side of which are some dense groups of trees. These used to be, very likely still are, tenanted every night of the cold weather by myriads of mynas ; and, evening after evening, the tumult attending their settling down for the night could be distinctly heard all across the wide intervening space."

It seems unlikely that the attacks of the comparatively few birds of prey can make any appreciable impression on the numbers of species, such as the above, which are so numerous in individuals.

If, owing to the lack of space, many individuals of such species are unable to breed, the casualties due to birds of prey must rapidly be made good. Every adult killed means one mouth less to feed, and, in consequence, a correspondingly greater area available for birds that want to breed.

(ii) OWLS

It is difficult to observe owls because of their nocturnal habits. The little information we have of their diet in a state of nature is largely derived from the pellets they cast up.

Some thirteen species are known to capture birds in India.

LONG-EARED OWL—*Asio otus*

This species subsists chiefly on mice, moles and insects, but occasionally takes small birds.

BROWN WOOD-OWL—*Syrnium indrani*

In captivity this species eats small birds, lizards and fish.

BROWN FISH-OWL—*Ketupa zeylonsis*

Despite its name this bird does not confine its diet to fish. In captivity it eats readily mice, lizards and birds. A. Hume records (*N. and E.*, III. 97) that in the Etawah district he came upon a nest of this owl which held one young bird. On the nest he found two quails, a pigeon, a dove and a myna, all with the head, neck and breast eaten away, but with the rest of the body intact. Some of these were quite dry, and one fresh, so that this bag was the product of several nights' hunting.

BARN OWL—*Strix flammea*

This birds feeds largely on mice and shrews, but not infrequently takes birds. E. R. Blewitt records (*N. and E.*, III. 94) finding in a nest containing seven young barn owls the remains of a painted partridge (*Francolinus pictus*).

The same observer remarks that in captivity these owls, when fed with the flesh of owls, kites or hawks invariably disgorge it, no matter how disguised. Small

birds, their favourite food, were swallowed whole. G. Vidal, however, writes (*N. and E.*, III. 94) that a young barn owl which was shut up with a young mottled wood owl (*Syrnium ocellatum*), "quite as large and nearly as old as itself, killed and ate a large portion of its cage-fellow one night."

Eagle Owl—*Bubo ignavus*

This species is believed to be destructive to game birds and is said to take a good many crows. Hume writes (*My Scrap Book*, p. 377): "It affects mountainous and wooded countries, and preys upon quadrupeds and birds, such as fawns, hares and grouse."

Rock Horned Owl—*Bubo bengalensis*

The remains of a peafowl were found in the stomach of an individual of this species. (*Bombay Gazetteer*, Vol. X., p. 59.)

Dusky Horned Owl—*Bubo coromandus*

Hume writes of this species (*My Scrap Book*, p. 374): "The birds seem to be omniverous; no doubt rats and birds, especially the latter, are their favourite food, but I have found in their stomachs remains of both frogs and jungle lizards."

This owl appears to be very partial to crows. J. R. Cripps found (*N. and E.*, III. 103) in one nest fifteen heads of young crows.

H. Whistler believes (*B.N.*, April, 1914, p. 133)

that in the Jhelum district this species is the cause of "immense mortality" among the crows. Anderson saw (*F.*, III. 287) a dusky horned owl pursuing a heron.

FOREST EAGLE OWL—*Huhua nepalensis*

This owl is said to kill pheasants.

LARGE BARRED OWLET—*Glaucidium cuculoides*

This occasionally captures birds. G. C. Dudgeon (*B.*, XIII. 530) once saw one kill a quail (*Coturnix communis*) in the snow. It could not fly off with its victim, not having the strength to carry so heavy a load.

JUNGLE OWLET—*Glaucidium radiatum*

This, like most of the small owlets, is insectivorous. There are records of its taking small birds. It was seen (*Bombay Gazetteer*, Vol. X, p. 60) to swoop at a wounded tree-warbler.

Hume writes (*My Scrap Book*, p. 410): "It kills and devours all kinds of small birds, even taking them in the daytime. I had one caught which came down at a chicken three times all by itself, and killed it in broad daylight. The chicken was set in a trap for a changeable hawk-eagle." He further relates the following of three jungle owlets he kept in captivity: "A pair of sparrows made a nest on the interior cornice of the enclosed end of the verandah in which they lived. At first the sparrows teased and bothered

the owls, the whole day long at intervals, the owls merely retreating inside their box, chattering angrily, but one night two of the three got loose, killed both sparrows, eating their breasts and entrails, and all the young ones of which not a trace was left."

Collared Pigmy Owlet—*Glaucidium brodiei*

This owlet seems to prey largely on small birds. E. C. Stuart Baker writes (*B.*, XI. 231): "Davidson saw it devouring a young barbet. I have seen unmistakable remnants of various kinds of birds in its nest-holes—barbets, scimitar babbler and black bulbul."

The same observer records (*B.*, XIII. 569) that he saw one of these owlets in the act of eating a young male minivet (*Pericrocotus speciosus*), the marks on which showed that the owl had killed it.

B. B. Osmaston reports (*B.*, XI. 72) one killing its fellow in captivity.

Spotted Owlet—*Athene brama*

If this very abundant species were habitually to kill small birds it would be an effective check on their numbers, but, so far as my observations go, it is purely insectivorous. In places where there are street lamps these owlets may be seen any night hawking the flying insects attracted by the light.

The only record of their taking a bird is that of Col. Butler, who writes (*N. and E.*, III. 110): "A friend of mine . . . found a nest in the hole of a

tree occupied by a pair of these birds containing two eggs of the owlet and one of a paroquet (*Palæornis torquatus*) and, as a portion of the remains of a paroquet were also found in the hole, it is assumed that the owlets attacked the paroquet and killed her on the nest, and, after the dark deed, took possession of the nest for themselves. All three eggs were fresh, as also the remains of the paroquet."

HUME'S BROWN HAWK-OWL—*Ninox obscura*

K. C. Macdonald records (*B.*, XVII. 488) that this species takes mynas.

Our knowledge of Indian owls being very limited, it is not possible to estimate with any accuracy the extent to which these birds check the growth of the population of other birds. Owls, owing to their nocturnal habits, are apt to elude observation, and some species are probably more numerous than we suppose them to be. It is not improbable that owls in India destroy very large numbers of birds annually. We must bear in mind that (as the incident of the jungle owlets and sparrows recorded by Hume shows) an owl can despatch with ease a sleeping bird from which it would flee in terror in the daytime.

Some idea of the effect of owls on the population of small birds may be gathered from the depredations of the little owl (*Athene noctua*) in England. W. J. Constable writes as follows (*Field*, February 17th, 1912): "The late Lord Lilford released

numbers of the little owl for a succession of years from his aviaries at Lilford. The result has been, so far as the neighbourhood of Uppingham is concerned, that this bird has become gradually naturalized, and is now, comparatively speaking, common. Records of the birds of this neighbourhood are published annually by the ornithological section of the Uppingham School N.S.S., and I am able to give the history of the gradual naturalization of this little owl. It began to be reported as an occasional visitor in the year 1895, and from that year onward the number of observations has gradually increased, until in 1905 it is described as 'not uncommon.' In 1909 it has become 'common, frequently seen and heard.' Last year, in fifteen expeditions of the society, it was seen once at least on every occasion, and sometimes six or seven were seen in the course of the afternoon; nests and eggs were frequently found. The actual number of observations sent in was fifteen, and these included thirty-one eggs and fourteen young. It is now more frequently seen than any other kind of owl, and may be heard on the outskirts of the town almost every night of the year. The nesting holes and larders have been examined in a great many instances, and, if we had only the evidence of the remains found there, little objection could be taken to the little owl. Its food consists of beetles and other insects and mice. We found remains of some, but very few, small birds, tits, wrens, etc., occasionally a young thrush or blackbird, once a water rat, but never any game. Keepers round about assert that they take both young part-

ridges and pheasants, but we have found no evidence to support the statement. But it so happens that the increased observation of the little owl coincides with a gradual but marked decrease in the numbers of small birds which were at one time common in the neighbourhood—whitethroats, warblers, chiff-chaffs, willow-wrens, and birds of this type. Even finches appear to be diminishing. At one time I ascribed this growing scarcity of small birds to the activity of the the County Councils in insisting on the trimming of roadside hedges and to the disturbance caused by the noise and dust of motor-cars. These two causes combined would account for the dearth of small birds on the high roads, but not in the country lanes, the edges of the woods, the gorse patches, and the hedges in the fields where the scarcity is quite noticeable. The little owl is diurnal as well as nocturnal in its habits, and the mischief arises from its hunting by day. The small birds must be continually disturbed by its almost ceaseless activity. Is it not natural that they should be driven further afield, especially in the breeding season, when they instinctively try to find quiet nesting-places?"

Lord Tavistock states (*B.N.*, March, 1919, p. 68) that the little owl in England while breeding kills a good many young blackbirds, thrushes and starlings, and not infrequently takes partridge and pheasant chicks as well.

It is not improbable that some of the smaller species of owl in India destroy numbers of nestlings of game and other birds; nor is it unlikely that in

Northern India the owls are most destructive to birds during the winter, when insect food is comparatively scarce.

This appears to be the case in England. Lord Tavistock writes (*loc. cit.*) of the tawny or brown owl (*Syrnium aluco*): "The brown owl in summer feeds mainly on mice and beetles, but I fancy an examination of its stomach in late winter would surprise its admirers—and shock them! If it is anything like as destructive to our native birds as it is to foreigners it must be a veritable scourge.

"At my old home in Bedfordshire it was impossible to keep any paroquet at liberty during the winter smaller than a cock rosella—the brown owls had every one, and they must have killed dozens, as well as tanagers, etc. Later a different set of owls took to killing full-grown chukor partridges and several were trapped at the half-eaten bodies of their victims. Here (Hampshire) it is the same story; I was more cautious about letting out small paroquets, but alas! the brutes carried off a beautiful cock barraband, whom I thought too big for them to tackle, and later, another large paroquet belonging to a weak-billed species."

As owls work mainly in the dark and capture sleeping birds, it is obvious that their victims are taken without respect to their being protectively coloured, or very vigorous, or possessing great wing power. Chance rather than natural selection determines which birds shall fall victims to the strigidæ.

(iii) THE CROW FAMILY

The crow family, owing to the abundance of some species and the systematic manner in which these seek out young birds and eggs, is an effective check on the growth of the population of small birds in India.

House Crow—*Corvus splendens*

Of the enemies against which birds have to contend in India, the house crow is, I believe, the chief. It probably does more to keep down the population of small birds than do all the raptores together. These latter usually attack only adults, and a bird of prey kills one adult where a crow destroys the whole of the contents of two or three nests. As regards numbers there must be in India more crows than there are birds of prey, excluding the kite.

More than twenty years ago I wrote of these crows (*The Indian Crow: His Book*, p. 17): "They know the season of nesting of each species of bird, and they raid every nest they discover. If they are so fortunate as to find young ones therein, they promptly devour them. The crows recently ate up three young bulbuls (*Molpastes*) which had been hatched out in the *chik*-house in my compound. If the young birds have not arrived, the black villains eat up the eggs."

It was not, however, till some years later that I realized the full extent of the depredations of the Indian corvi. In the *Pioneer*, dated October 3rd, 1919, I wrote: "During the past hot weather I

enjoyed excellent opportunities of watching these birds—Indian skimmers (*Rhynchops albicollis*)—at their nests. I must have seen over one thousand skimmers' eggs and I do not believe that thirty of these developed into adult birds. On two sand islets in the Ganges, opposite Ghazipur, not less than thirty clutches of skimmers' eggs were laid; taking the average clutch as three, this means ninety eggs. Of these only six or seven produced young birds, the remainder being eaten by crows; and of the young birds that did hatch out only one reached maturity. As the islets in question were close to a town, the percentage of destruction was probably unusually large. From sunrise to sunset there was unceasing warfare between the crows and the skimmers. These latter attacked every crow that visited the islets, but, unlike the black-bellied terns which were also nesting there, the skimmers never drove an attack home; they were content to fly a few inches behind a retreating crow. The crows invariably retired when attacked, but, while some were being chased, others flew to momentarily deserted nests and lifted eggs therefrom. I witnessed numbers of eggs being thus carried away. If the skimmers, instead of flying at the crows, had sat closely, they would have met with better success in their nesting operations on those islets. The terns which lay eggs on the sand islets in the Ganges suffer in the same way.

On other occasions I have seen crows carry off the eggs of sunbirds (*Arachnechthra asiatica*), babblers (*Crateropus canorus*) and mynas (*Acridotheres tristis*).

Every observer has the same tale to tell of the depredations of the house-crow.

E. H. Aitken writes (*The Common Birds of Bombay*, p. 121): "What I cannot forgive is the constant and ruthless massacre of innocents that goes on where crows are allowed their own way. They watch every little bird to find out if it has a nest, they count the days till the first young sparrow flutters out on its untried wings, they pounce upon it and carry it to the nearest tree and hold it under one foot and pick it to pieces, absolutely callous to the shrieks of the parents as they flutter round, distracted but helpless."

B. Aitken records (*N. and E.*, II. 266) that many young sunbirds (*Arachnechthra zeylonica*) fall a prey to crows.

H. Whistler observed (*B.N.*, July, 1914, p. 241) crows taking a clutch of eggs of the green pigeon (*Crocopus*).

Butler states (*N. and E.*, III. 234) that, when he visited a dense thicket of tamarisk trees in Sind, in which herons, egrets, cormorants, snake-birds, etc., were nesting, he experienced some difficulty in procuring the eggs he wanted, "as the instant the birds left their nests flocks of crows descended and carried the eggs off."

When visiting the breeding grounds of the purple heron (*Ardea manillensis*) on the Chilka Lake, I came upon two nests containing fresh eggs, of which in each case one had been punctured, almost certainly by crows.

Miss Cockburn says (*N. and E.*, II. 39) of the white-

spotted fantail fly-catcher (*Rhipidura pectoralis*): "These birds have built in the peach trees in our garden, and, although we are most careful that no one should touch their nests, squirrels, crows and crow-pheasants used to deprive them of their young. On these occasions the distress of the parents was sad to witness, but it seemed to last for only a few hours; before the day was ended their sweet song was resumed, and in less than a week another nest would be commenced."

G. Reid writes of this crow (*Ibis*, July, 1902): "It robs nests, if not habitually, at least occasionally, for I have more than once seen it despatching eggs with great gusto."

C. B. Ticehurst declares (*B.*, XXVIII. 798): "The worst thief of all is the house-crow. In the nesting season I always had a flock following me about all day in the cultivation, and I am certain that they watch one's doings with an eye to future evil intent; so certain was I that they did this, that I have fooled them by being very interested in nothing in a likely bush and have afterwards seen them fly to the bush to investigate."

My experience coincides with that of Ticehurst. Doubtless the crows are responsible for many of the losses recorded by egg-collectors, who have left nests containing eggs until the clutch should be complete.

The crow sometimes scores off its foe, the koel (*Eudynamis honorata*). C. D. Lester saw one (*B.*, XIV. 612) carrying in its bill a koel's egg which it deposited in a croton plant. Crows frequently kill

koels. At Lahore I came upon a cock koel so badly wounded that it was unable to fly. Butler (*N. and E.*, II. 395) saw two crows attacking a koel, which was so terrified as to allow Butler to pick it up. "The following day," he writes, "a beautiful female specimen was mobbed to death by crows in a compound next to mine and brought to me by the men who saw it killed."

Crows do not confine their attentions to open nests; they are quite capable of pulling a young bird out of a hole in a tree. Butler writes (*N. and E.*, III. 107) that he found a young scops owl (*Scops giu*), about ten or twelve days old lying at the foot of a tree alive, but with the head much bruised by the fall. He is of opinion that it was taken out of the nest by crows, as there were several in the tree and the parent owl was very excited. The nest hole was found to be empty and the other parent (the male) was discovered sleeping in another tree about fifty yards away.

In trying to estimate the damage to birds and eggs caused by crows it is necessary to bear in mind two facts. The first is that crows are both cunning and wary, and dislike being watched, hence most of their depredations are committed when they are not being observed. The second is their very large numbers. The population of crows numbers several millions. Many years ago I wrote in *Longman's Magazine*: "The best way to judge of the extent of the corvine population of a town is to take up a position on the roof of the most lofty house in the place, just as the

sun is about to sink below the horizon, and from this point of vantage watch the crows as they wend their way homeward after the labours of the day."

Crows, although the sworn enemies of man, like to roost in his vicinity. The crows of a locality sleep in colonies on trees, preferably near human habitations. During the day they spread themselves over a considerable area, but at eventide they all return to their roosting place.

I once watched the home-coming of the crows from the roof of a house situated on a hillock in the little station of Rajahmundry, on the Godaveri river. For the greater part of an hour the birds returned in several continuous streams. Such numbers arrived simultaneously that I found it impossible to count them. However, it is no exaggeration to say that upon that particular evening some ten thousand crows flew over my head.

Some came in from the river banks, others returned from the islets and sand-banks which stud every Indian river when it is not in flood. Many flew in from hamlets on the opposite side of the broad stream. Multitudes poured in from the neighbouring fields and jungles. Considering that I could only see the birds which entered the station at one corner, and bearing in mind that a great many birds never leave the station, the corvine population of that little settlement cannot have been much less than fifty thousand. Probably over a million crows dwell in Calcutta.

In addition to the destruction they work among

eggs and young birds, crows act as a check on nesting operations, by persistently annoying large birds at the nest. They seem to revel in worrying kites when these are building. Who is there who has not noticed the continual bickering that goes on between the two species at this period? That crows do not always limit themselves to mere worrying is evident from the following note made by me on March 6th, 1906: "Saw a number of crows mobbing a kite that had been sitting for fully three weeks. The kite was in the nest and about twenty crows were perched in the tree, each cawing loudly. They were moving about in the tree and appeared to be closing in on the kite. Presently the kite came out of the tree pursued by two or three of the crows. She flew about as though dazed and then returned to the nest. After a little I went on my way. On my return, half an hour later, the mobbing was still in progress, and the crows had become bolder; some were quite close to the nest, if not actually on it. I again visited the spot some six hours later. There were a few crows in the tree, but no kite was to be seen. The nest had been partially pulled down. On searching the ground beneath the tree, I found two crow's wings and a mass of kite's feathers, including six of the tail. The kite must have taken a wounded or sickly crow for her young and the crow community must have retaliated. They seem to have worried the kite until she was so exhausted or bewildered that they were able to kill and devour her. They probably made a meal off the nestlings."

A pair of white-eyed buzzards (*Butastur teesa*) that began nesting operations in my garden at Pilbhit had to desist on account of the way in which they were worried by the crows.

Similarly at Saharanpur a pair of white-necked storks (*Dissura episcopus*) failed in their attempt to build a nest owing to the way in which they were mobbed by the local crows.

Crows will attack any strange species of bird they see. Whenever an owl ventures forth by day it is mobbed by them. At Lahore a cockatoo escaped from its cage. It had not gained freedom one hundred and fifty seconds before it attracted the notice of a crow. In a few minutes it was being buffeted by more than a dozen corvi, and I have no doubt that these soon killed it.

This rooted objection of crows to any strange-looking bird doubtless prevents many large species from extending their range in India.

D. D. Cunningham, in his *Some Indian Friends and Acquaintances* (p. 243), gives an instance of this. Writing of Calcutta, he says: "At intervals a specimen of Pallas' fishing eagle (*Haliaëtus leucoyphus*), or of the white-bellied sea-eagle (*H. leucogaster*), will descend to meditate among the trees overhanging a pond. In large gardens, which, like the Botanic Garden at Sibpur, enjoy an exceptional immunity from crows, they will often remain for some time, and may even occasionally nest, but in other cases they are not allowed a chance of doing so, for hardly have they settled themselves down to gaze into the

water, ere some officious crow discovers their presence and vociferously summons its fellows to the spot. The unwelcome visitor is presently surrounded by a clamorous mob, that steadily grows, and gradually presses in around him so long as he remains motionless, but disperses at once with shouts of execration on his slightest movement, only, however, to gather anew and resume the congenial task of annoyance. For a time the eagle may maintain his position in dignified endurance, but, sooner or later, his patience wears out, and he sails off to seek a quieter resting place."

The Indian house-crow, then, is certainly a powerful check on the population of other birds, quite apart from the fact that the species, owing to its numbers, makes a great demand on the food supply of the country.

As I have suggested later (p. 210), the crows are probably responsible for the restriction in the range of Horsfield's nightjar (*Caprimulgus macrurus*) which has occurred of recent years.

Jungle Crow—*Corvus macrorhynchus*

The jungle crow, or Indian corby, is no less ruthless in its attacks on nestlings and eggs than the house-crow, but, as it is less common in the plains, its depredations are not so great. In the Himalayas, however, where it largely replaces the house-crow, it is a veritable scourge to the population of small birds.

H. A. F. Magrath writes (*B.*, XVIII. 285): "The depredations committed by these crows on the eggs and young of smaller birds are extensive, and a large part of their daily food in the breeding season is thus obtained."

P. T. L. Dodsworth states (*A.M.*, March, 1912) that the eggs and young of the kokla green pigeon (*Sphenocercus sphenurus*) suffer much from the depredations of jungle crows.

R. Thompson states (*N. and E.*, II. 355): "The Indian corby is a vile and bitter enemy of *Turtur suratensis* and all other doves, prosecuting his search for their eggs and young with the most unflagging energy."

P. T. L. Dodsworth observed (*B.*, XXI. 66) these crows feasting on crag-martins (*Ptyonoprogne rupestris*) when they arrived at Simla exhausted by their migratory flight; he says they "literally speaking, gorge themselves on these hapless birds."

H. Stevens records (*B.*, XXI. 235) that in Upper Assam the corby does much damage to the nests of the baya (*Ploceus baya*) and the king-crow (*Dicrurus ater*).

S. L. Whymper tells (*B.*, XVII. 817) how he caught these crows in the act of rifling a nest of the Himalayan nutcracker (*Nucifraga hemispila*). The nest in question contained eggs. The nutcrackers made a great fuss while the eggs were being taken.

O. C. Ollenbach observed (*B.*, XXVIII. 800) a jungle crow carrying off a myna's egg and another an oriole nestling (*Oriolus kundoo*).

I once witnessed a corby seize and carry off a myna fledgling (*Acridotheres tristis*).

L. Alexander saw some of these crows mob and kill a great Himalayan barbet (*Megalæma marshallorum*). He drove the crows off and found that the neck of the barbet was dislocated. Whether the dislocation was the work of the crows or was due to accident and the crows attacked the disabled bird is not known. Crows invariably attack wounded birds, even those of their own species.

W. Jesse writes (*Ibis*, July, 1902, p. 479): "Amongst my papers I find a curious note given me by Mr. J. Spence. . . . Whilst rowing one evening on the Gumpti river, near Lucknow, this gentleman was attracted by a curious noise, and on turning round saw a corby outside a sand-martin's hole. Every now and then it would utter a call, and if, as my informant expressed it, any poor little half-fledged sand-martin was fool enough to come to the mouth of the hole to find out what was up, it was promptly seized and devoured."

Jungle crows do not worry big birds to the same extent as house-crows do, but they occasionally do so. H. Stevens records that they drove a long-legged buzzard (*Buteo ferox*) out of a tree in his garden.

Indian Tree-pie—*Dendrocitta rufa*

This bird is very destructive to eggs and nestlings of small birds. On page 7 I have recorded the destruction of the eggs and young of three pairs of

bulbuls. I believe that a tree-pie, which used to visit and explore my verandah at Ghazipur daily in search of moths and insects, was the cause of the disappearance of the eggs of a spotted dove (*Turtur suratensis*) from a nest in the verandah.

G. Reid writes of the tree-pie (*Ibis*, July, 1902, p. 481): "A specimen that I shot had evidently robbed some nest, for its bill was smeared with the yolk of eggs. On another occasion I actually caught one in the act of robbing a babbler's nest."

E. H. Gill saw (*B.*, XXIX. 107) a tree-pie rifling a nest of the white-eye (*Zosterops palpebrosa*).

A. Begbie (*B.*, XVI. 502) disturbed a tree-pie while devouring a young brown-backed robin (*Thamnobia cambayensis*). The pie had eaten the head and was engaged on the right wing when driven away by Begbie.

C. M. Inglis writes (*B.*, XIII. 622): "This bird is an arrant robber and destroys many eggs during the year. I once saw one deliberately turn upside down the nest of the tailor-bird (*Orthotomus sutorius*) and let two of the eggs drop on the ground; why it did not simply tear open the nest, I can't imagine." He adds that the pie destroys many nests of the tailor-bird.

The same observer records finding many deserted nests of the white-eye. He thinks that the nests are sometimes deserted on account of the way in which the tree-pie persecutes the owners. Later he records (*B.*, XIV. 133) that many nests of the paradise fly-catcher (*Terpsiphone paradisi*) are destroyed by tree-pies.

R. Thompson remarks (*N. and E.*, II. 355) that the tree-pie is a great thief of eggs.

D. D. Cunningham writes (*Some Indian Friends and Acquaintances*, p. 89): "Tree-pies are always on the look-out for plunder, and may often be seen flying about with stolen eggs in their bills." He points out how the doves "are at once on the war-path whenever a tree-pie makes his appearance. . . . The exceptionally conspicuous and defenceless nature of their nests and the fact that eggs and young birds are to be found in them at all times of the year are very sufficient reasons why doves should show a special animosity to such marauders."

J. M. Paterson writes (*B.N.*, September, 1912, p. 236): "The tree-pie is the sworn foe of all small birds in India and he is very fond of eggs and never loses a chance of eating any he may get hold of. As soon as he is satisfied that the sunbird's nest (near his own) contains eggs, he pays it a visit, and, making his way cautiously to the end of the twig to which it is fastened, he tears away the front of the beautiful little structure, sticks his bill into an egg, places one foot upon it, eats the contents and then swallows the shell. The same fate follows the second egg, and the robber goes on his way to find other nests and other eggs."

C. R. Cock, writing of Tickell's flowerpecker (*Diæcium erythrorhynchum*), says (*N. and E.*, II. 276): "The nest is generally high up and placed under a thick bunch of leaves to hide it from that pirate, *Dendrocitta rufa*, but not always successfully, as I have

found to my sad experience. I may here remark that I wage war with *D. rufa* and do not tolerate them in my favourite *baghs* and *topes*, for many are the good eggs they have deprived me of."

L. G. Tomkins informs me that he saw a tree-pie devouring a nestling from a robin's nest (*Thamnobia cambayensis*) in his verandah.

T. de Gruyther writes (*B.*, XXVIII. 799): "For years I had noticed the destruction of nests as described by Mr. Bolster, and only last year (1921) I discovered the cause. I watched a tailor-bird build its nest in a vine which overhangs my study window, and, later, I saw one of the birds sitting in the nest, which one day I noticed contained three tiny eggs. Two or three days after I answered their calls of distress and arrived in time to drive off a tree-pie, which had torn one side of the nest and dislodged two of the young. With a needle and thread I repaired the nest and replaced the little ones, which I was glad to see take wing a fortnight later. On two occasions the cries of the munias which had built in a creeping rose hard by my verandah steps, and of the bulbuls which had taken possession of an aralia in my verandah, brought me out; and on each occasion I saw the same bird rifle the nests. A honeysucker's nest was destroyed in my absence, but I have no doubt the *Dendrocitta rufa* knew something about it."

O. C. Ollenbach says of the tree-pie (*B.*, XXVIII. 800): "The destruction caused by this bird is appalling. I have noticed these birds for several years now and only wonder that any nests of small birds escape

destruction. Whether they feed their young on the eggs and young of other birds while they are nestlings I cannot say, but they certainly do so after the brood is able to fly. For the past few years a pair of *D. rufa* have visited this place accompanied by their brood, from two to four almost full-grown youngsters, and have made a systematic search of all the trees and bushes in my garden. It is generally in early July that they come, and it is also just about the time when most birds have eggs or young. During these visits I have always found that all the nests have been cleared out, and no matter how well a nest may have been placed it never escaped destruction.

"During August, 1919, I had over a dozen nests of weaver birds (*Ploceus baya*) (Blyth) under observation. These nests were hung from some thorny bushes a few feet from the ground. I visited these daily and on the 14th August noticed that some had young, as the parent birds were feeding them. The next day on my arrival I found the whole family of *D. rufa* (two parent birds and three young) engaged at the nests and just finishing their work of destruction. They had torn a hole in each nest, just sufficiently large to admit their heads, just at the spot where the nest bulges and had extracted and devoured the contents."

H. Whistler once saw (*B.N.*, October, 1914, p. 345) a tree-pie devour an adult weaver-bird. This caused great excitement among other members of the weaver colony.

W. F. Biscoe records (*B.*, XIII. 184) seeing three magpies attack and kill a full-grown bulbul.

There are fully a dozen species of pie found in India, and all of them doubtless attack eggs and nestlings, but in the case of most kinds of magpie there is little on record regarding their habits.

In the Himalayas *Dendrocitta rufa* is replaced by the Himalayan tree-pie (*D. himalayensis*) and the magnificent red-billed and yellow-billed blue magpies (*Urocissa occipitalis*) and (*U. flavirostris*). H. A. F. Magrath says (*B.*, XVIII. 285) that the last-named species lives in the breeding season by harrying the nests of other birds.

As there is a goodly number of corvidæ in every bird-inhabited locality of India, the members of the crow family must be responsible annually for the destruction of millions of eggs and nestlings.

(iv) CUCKOOS

The parasitic cuckoos constitute a powerful check on the growth of the population of the species which they victimize.

Most cuckoos remove one of the legitimate eggs at the time of depositing their own in the dupes' nest. The young of some cuckoos, when they are one or two days old, eject any eggs or nestlings that happen to be in the nest. In some cases where the young do not do this, the foster-parents themselves turn out their own young in order to make room for the intruder. For our knowledge of this fact we are indebted to Burnett, who discovered that the wren-

warbler (*Prinia socialis*), when victimized by the Indian plaintive cuckoo (*Cocomantis passerinus*) throws its own young out of the nest within twenty-four hours of the cuckoo being hatched. Finding the legitimate young on the ground, Burnett "put them back three or four times in two nests, but it was no good; they were regularly turned out again."

This behaviour of the foster-parents is quite in accord with what has been observed of birds which have not been victimized by cuckoos turning out the weaker of their nestlings. (See p. 81.)

As we have seen, most species lay more eggs than the number of young they are able to feed, and so it is in the interest of the race that the weaker or the more backward nestlings should be put out of the nursery. The instinct which teaches birds to turn out of the nest young they cannot rear is apt to be at fault when abnormal circumstances arise, as when the most vigorous nestling happens to be a cuckoo.

So far as I am aware, the young koel (*Eudynamis honorata*) is the only cuckoo in India which is habitually reared along with its foster-brethren. The young koel does not eject its foster-brethren nor do the crows. The crow is a bigger bird than the koel, and so there is not the same necessity for it to eject any of its offspring as there is in the case when the foster-parents are tiny birds. The ejection of the legitimate nestlings in cases where the dupe is much smaller than the cuckoo simply means that the nestlings die quickly from starvation instead of slowly.

The koel, like other parasitic cuckoos, removes a

legitimate egg at the time of placing its own in the nest, and so throws no additional burden on the parent crows.

In considering the importance of cuckoos as a check on the population of the species on which they are parasitic, it is necessary to bear in mind that after a crow, or other rapacious creature, eats the eggs in a nest or these are destroyed by any other cause, the parents usually lay a fresh clutch, but when the cuckoo has laid its egg in a nest, the legitimate eggs do not yield young and the dupes lay no eggs to replace the legitimate ones.

The potency of cuckoos as a check on the population of their victims depends on the numbers of female cuckoos that breed every season and the number of eggs which they lay, or, rather, for which they are able to find suitable nests. In the case of every species, with the exception of the koel, every cuckoo's egg laid in the nest of a dupe means that one pair of birds will rear no young in that season. A species of which every pair was victimized by cuckoos would in a few years become extinct.

The observations of E. Chance and others (see *The Cuckoo's Secret*, by Edgar Chance) show that the European cuckoo (*Cuculus canorus*) lays about twenty eggs in a season. If each of these eggs be deposited in a separate nest, every cuckoo prevents twenty pairs of birds rearing legitimate young every year.

Now *C. canorus* is very abundant in the Himalayas; it therefore must operate as a very serious check on the growth of the population of the species which it

victimizes. Presumably because it is so numerous it appears to be very catholic in its selection of nests in which to lay. If it were to confine its attentions to one host it would not be able to find nearly sufficient nests for its eggs.

The only parasitic cuckoos which are really abundant in India are the common hawk-cuckoo (*Hierococcyx varius*), the koel (*Eudynamis honorata*), the pied crested cuckoo (*Coccystes coromandus*) and the Indian cuckoo (*Cuculus micropterus*) in the plains, and the common cuckoo (*C. canorus*), the large hawk-cuckoo (*Hierococcyx sparverioides*), and the Himalayan cuckoo (*C. saturatus*) in the Himalayas.

All these are effective checks to the population of their dupes.

The koel, although exceedingly abundant in the plains, is not so effective a check as the others, because the rearing of its young does not involve the destruction of the legitimate occupants of the nest.

Some idea of the amount of destruction caused by cuckoos where they are numerous may be gathered from the observations made by J. M. D. Mackenzie at Maymyo, Burma (*B.*, XXV. 745). Of fifteen nests of the necklaced laughing thrush (*Moniliger pectoralis*) found, eleven contained cuckoos' eggs, and rats and crows took the eggs out of two of the rest.

"This," writes Mackenzie, "means a loss of thirteen out of fifteen nests, 14 per cent being all that run any chance of successfully hatching out, unless the cuckoos' eggs were addled; and in all but one nest, two or more cuckoos' eggs would have to be

addled. It seems extraordinary that the laughing thrushes do not rapidly disappear under such adverse conditions." Eliminating the crows and rats, the cuckoos were responsible for the loss of nearly 80 per cent of the eggs of laughing thrushes laid at Maymyo.

At present our knowledge of the oology of the Indian parasitic cuckoos is very incomplete. I give below a list of the various species and the birds in the nests of which their eggs have been found. An asterisk against any species denotes that this species is a common dupe. The list has been largely compiled from the papers contributed by E. C. Stuart Baker to Volume XVII of the Journal of the Bombay Natural History Society. The lists of dupes are certainly not complete. Doubtless when the ordinary dupe becomes rare most cuckoos resort to other nests, hence the numbers of kinds of species victimized must tend to increase.

Common Cuckoo—*Cuculus canorus*

The egg of this cuckoo has been found in the nests of the following:

Indian Bush-chat—*Pratincola maura.*
Common Pied Bush-chat—*P. caprata.*
Hodgson's Shortwing—*Hodgsonius phœnicuroides.*
Blue-headed Rock-thrush—*Petrophila cinclorhyncha.*
*Dark Grey Bush-chat—*Oreicola ferrea.*
*Indian Blue Chat—*Larvivora brunnea.*
White-cheeked Bulbul—*Molpastes leucogenys.*
Tickell's Ouzel—*Merula unicolor.*

Western Spotted Forktail—*Henicurus maculatus.*
Slaty-backed Forktail—*H. schistaceus.*
Hodgson's White-gorgeted Flycatcher—*Anthipes moniliger.*
Nepal Shortwing—*Drymochares nepalensis.*
Jungle Babbler—*Crateropus canorus.*
Rufous-backed Shrike—*Lanius erythronotus.*
Magpie-Robin—*Copsychus saularis.*
*Upland Pipit—*Oreocorys sylvanus.*
*Brown Rock-pipit—*Anthus similis.*
*Hodgson's Pipit—*A. rosaceus.*
Brown Hill Warbler—*Suya crinigera.*
*Rufous Fantail Warbler—*Cristicola cursitans.*
*Blyth's Pipit—*Anthus striolatus.*
*Indian Pipit—*A. rufulus.*
Austen's Hill Warbler—*Suya khasiana.*
Phayre's Scimitar-Babbler—*Pomatorhinus phayri.*
Black-headed Shrike—*Lanius nigriceps.*
Rufous-bellied Niltava—*Niltava sundara.*
Tailor-bird—*Orthotomus sutorius.*
Common Wren-warbler—*Prinia inornata.*
Mandelli's Tit-babbler—*Pellornia mandellii.*
Red-billed Liothrix—*Liothrix luteus.*
Brown Bush-warbler—*Tribura luteiventris.*
Maclelland's Scimitar-Babbler—*Pomatorhinus macllellandi.*
Black Bunting—*Melophus melanicterus.*
Silver-eared Mesia—*Mesia argentuaris.*

This cuckoo seems invariably to remove an egg from the nest in which it deposits its own egg. Some-

times, at any rate, it eats the legitimate egg. Hodgson records (*N. and E.*, II. 52) coming upon a nest of the dark grey bush-chat (*Oreicola ferrea*) which contained four eggs. A *Cuculus canorus* ate two of the four eggs, whilst being hatched.

Himalayan Cuckoo—*C. saturatus*

The egg of this cuckoo has been found in nests of the following :

*Large Crowned Willow-warbler—*Acanthopneuste occipitalis.*
Hume's Willow-warbler—*Phylloscopus humii.*
*Rufous-bellied Niltava—*Niltava sundara.*
Verditer Flycatcher—*Stoparola melanops.*
Rufous-necked Scimitar-Babbler—*Pomatorhinus ruficollis.*

The nestling of this species ejects everything in the nest.

Small Cuckoo—*C. poliocephalus*

The egg of this cuckoo has been found in the nests of the following :

Rufous-bellied Niltava—*Niltava sundara.*
Small Niltava—*N. macgrigoriæ.*
Indian Bush-chat—*Pratincola maura.*
Chestnut-headed Shortwing—*Oligura castaneicoronata.*
Large Crowned Willow-warbler—*Acanthopneuste occipitalis*

Blyth's Crowned Willow-warbler—*A. trochiloides.*
Crested Black Tit—*Lophophanes melanolophus.*
Eastern Bush-Warbler—*Cettia orientalis.*
Pale Bush-Warbler—*Horornis pallidus.*
Scaly-breasted Wren—*Pnoepyga squamata.*
White-browed Shortwing—*Drymochares cruralis.*

INDIAN CUCKOO—*C. micropterus*

The egg of this cuckoo has been found in the nests of the following :

Himalayan Streaked Laughing-Thrush—*Trochalopterum lineatum.*
Western Variegated Laughing-Thrush—*T. simile.*
Indian Blue Chat—*Larvivora brunnea.*
Brown Hill-Warbler—*Suya crinigera.*
Golden Bush-Robin—*Tarsiger chrysæus.*
Rufous-bellied Niltava—*Niltava sundara.*

LARGE HAWK-CUCKOO—*Hierococcyx sparverioides*

The egg of this cuckoo has been found in the nests of the following :

Himalayan Whistling-Thrush—*Myiophoneus temmincki.*
Himalayan Streaked Laughing-Thrush—*Trochalopterum lineatum.*
Western Yellow-winged Laughing-Thrush—*T. nigrimentum.*
Hoary Bar-wing—*Ixops nepalensis.*

Assam Babbler—*Pellorneum ignotum.*
*Larger Streaked Spider-Hunter—*Arachnothra magna.*
Nepal Babbler—*Alcippe nepalensis.*
Small Niltava—*Niltava macgrigoriæ.*
Blue-throated Flycatcher—*Cyornis rubiculoides.*
Nepal Shortwing—*Drymochares nepalensis.*
Mandelli's Spotted Babbler—*Pellorneum mandellii.*
Hume's Babbler—*Stachyrhidopsis rufifrons.*
Black-throated Babbler—*Sachyris nigriceps.*
Necklaced Laughing-Thrush—*Garrulax moniliger.*
Rufous-chinned Laughing-Thrush—*Ianthocincla rufigularis.*
Red-billed Liothrix—*Liothrix luteus.*
Brown Shrike—*Lanius cristatus.*
Austen's Hill-Warbler—*Suya khasiana.*

COMMON HAWK-CUCKOO—*Hierococcyx varius*

This species seems to confine its attention almost exclusively to babblers. Its eggs are invariably to be found in the common babbler of the locality, namely, the jungle babbler (*Crateropus canorus*) in Northern India, the rufous-tailed babbler (*C. somervillii*) in Western India and the white-headed babbler (*C. griseus*) in South India.

The cuckoo nestling appears to eject its foster-brethren, as I have always found the young cuckoo alone in a babbler's nest.

Collet once found a babbler's nest containing nine eggs of this cuckoo and one legitimate egg; that must have been in a locality where babblers were unusually

uncommon. In most parts of India there are sufficient babblers' nests to render it unnecessary for this cuckoo —the " brain-fever bird " of Europeans—to lay more than one egg in the nest of each dupe.

Hodgson's Hawk-Cuckoo—*H. nisicolor*

The egg of this cuckoo has been found in the nests of the following :

Golden-headed Warbler—*Phyllergates coronatus.*
Hume's Babbler—*Stachyrhidopsis rufifrons.*
Small Niltava—*Niltava magrigoriæ.*
Blue-throated Flycatcher—*Cyornis rubiculoides.*
Rufous-breasted Blue Flycatcher—*C. hyperythrus.*
Little Spider-hunter—*Arachnothera longirostris.*
Squamated Babbler—*Turdinulus exul.*
Large Niltava—*Niltava sundara.*
Mandelli's Spotted Babbler—*Pellorneum mandellii.*
Nepal Babbler—*Alcippe nepalensis.*
Burmese Babbler—*A. phayri.*
Austen's Babbler—*Drymocataphus assamensis.*

Indian Plaintive Cuckoo—*Cacomantis passerinus*

The egg of this cuckoo has been found in the nests of the following :

Wren-Warbler—*Prinia inornata.*
*Ashy Wren-Warbler—*P. socialis.*
Yellow-eyed Babbler—*Pyctorhis sinensis.*
Rufous-backed Shrike—*Lanius erythronotus.*

Red-vented Bulbul—*Molpastes bengalensis.*
*Tailor-bird—*Orthotomus sutorius.*
Small Minivet—*Pericrocotus peregrinus.*
Fantail Warbler—*Cisticola cursitans.*

The young of this cuckoo does not appear to turn out the other nestlings or eggs, but, as has been mentioned, Burnett observed (*B.*, XVII. 886) the foster-parents—*P. socialis*—throw out their own young to make room for the cuckoo nestling.

This is one of the smaller cuckoos, and some of its dupes are nearly as large as itself, hence there is not the same need for the cuckoo nestling to turn out the contents of the nest as there is in the case of the cuckoos which victimize birds considerably smaller than themselves.

Rufous-bellied Cuckoo—*Cacomantis merulinus*

The egg of this cuckoo has been taken in the nest of the Himalayan yellow-backed sunbird (*Æthopyga scheriæ*).

Banded Bay Cuckoo—*Penthoceryx sonnerati*

The egg of this cuckoo has been found in the nests of the following :

*Iora—*Iora tiphia.*
Southern Red-whiskered Bulbul—*Otocompsa fuscicaudata.*
Small White-throated Babbler—*Dumetia albigularis.*

VIOLET CUCKOO—*Chrysococcyx xanthorhynchus*

The eggs of this cuckoo have been found in the nests of the following :

Abbot's Babbler—*Turdinus abboti.*
Roberts' Babbler—*T. roberti.*
*Nepal Babbler—*Alcippe nepalensis.*

EMERALD CUCKOO—*Chrysococcyx maculatus*

The eggs of this cuckoo have been found in the nests of the following :

Strong-footed Bush-Warbler—*Horornis fortipes.*
Brown Bush-Warbler—*Tribura luteiventris.*
*Red-headed Babbler—*Stachyrhidopsis ruficeps.*
Slaty-bellied Shortwing—*Tesia cyaniventris.*
*Black-throated Babbler—*Stachyris nigriceps.*
Tailor-bird—*Orthotomus sutorius.*

DRONGO CUCKOO—*Surniculus lugubris*

The eggs of this cuckoo have been found in the nests of the following :

*Indian Ashy Drongo—*Dicrurus longicaudatus.*
Leschenault's Forktail—*Henicurus leschenaulti.*
Striated Marsh-Warbler—*Megalurus palustris.*

It also seems to victimize bulbuls and shrikes.

PIED CRESTED CUCKOO—*Coccystes jacobinus*

The eggs of this cuckoo have been found in the nests of the following :

Nepal Babbler—*Alcippe nepalensis.*
*Large Grey Babbler—*Argya malcolmi.*
*Common Babbler—*A. caudata.*
*Streaked Babbler—*A. earlii.*
*Jungle Babbler—*Crateropus canorus.*
*White-headed Babbler—*C. griseus.*
*Southern Indian Babbler—*C. striatus.*
*Rufous-tailed Babbler—*C. somervillii.*
*Ceylonese Babbler—*C. rufescens.*
Necklaced Laughing-Thrush—*Garrulax moniliger.*
Nilgiri Laughing-Thrush—*Trochalopterum cacchinans.*

The young of this species seems to eject everything else in the nest. Whenever I have come upon this nestling in a babbler's nest, it has invariably been alone, nor have I ever seen any young babblers accompanying a young pied crested cuckoo when following its foster-parents. J. L. Hervey witnessed (*B.*, XVII. 893) this species carrying in its bill a babbler's egg.

RED-WINGED CRESTED CUCKOO—*Coccystes coromandus*

The eggs of this species have been found in the nests of the following :

*Necklaced Laughing-Thrush—*Garrulax moniliger.*
*Black-gorgeted Laughing-Thrush—*G. pectoralis.*

McClelland's Laughing-Thrush—*G. gularis.*
Burmese Black Bulbul—*Hypsipetes concolor.*
Rufous-chinned Laughing-Thrush—*Ianthocincla rufigularis.*
McClelland's Scimitar Babbler—*Pomatorhinus macclellandi.*

This cuckoo also victimizes the quaker thrushes.

Indian Koel—*Eudynamis honorata*

This very abundant cuckoo victimizes chiefly the Indian house-crow (*Corvus splendens*) and in Burma the Burmese house-crow (*C. insolens*). It dupes to a lesser extent the Indian corby (*C. macrorhynchus*).

The eggs of the koel have also been found in the nests of the magpie (*Pica rustica*) on two occasions in Burma by Harington (*B.*, XV), also in the nest of the Chinese magpie (*P. serica*) (*B.*, XIX. 108).

C. M. Inglis found (*B.*, XVII. 684) its eggs in the nest of the common myna (*Acridotheres tristis*). The same observer saw (*B.*, XIII. 629) a hen koel robbing a nest of the Indian oriole (*Oriolus kundoo*). The koel had almost disposed of one egg and the oriole was flying about screaming when Inglis arrived on the scene. G. Dalgleish saw (*A.M.*, October, 1907, p. 357) a koel take an egg from a dove's nest and fly off with it in the bill.

The koel not infrequently lays more than one egg in the same nest. A. Begbie once found eight, and once four, koel's eggs in a crow's nest (*B.*, XVI. 746).

The koel, when depositing an egg, usually removes

a legitimate one. As a result of investigations made in 1906 I wrote (*B.*, XVII. 782): "I consider it proven that the koel undoubtedly destroys or tries to destroy some of the crow's eggs it finds in the nest. My idea is that, given the opportunity, the koel will destroy all the crow's eggs. Unfortunately there was so much tampering with the nests that came under my observation that the evidence on this point, as indeed on most points, is not so conclusive as I could wish. However, I have no reason to think that nest Number VI was tampered with by human beings, yet all the crow's eggs disappeared. Then there is the nest we found containing only two koel's eggs which were nearly incubated. Lastly, there is the incident of the broken crow's egg on the ground under nest Number X.

"Equally clear is it, in my opinion, that the young koel does not eject either the crow's eggs or its fellow-nestlings. In the case of nest Number II three young crows and a koel were reared up and fledged, in nest Number VI two young koels, and in nest Number IX a koel and two crows. . . . I think I have said sufficient regarding the young koel's lack of that peculiar irritability which characterizes the common cuckoo. It is possible that the young koel may sometimes turn a crow nestling out of the nest, but this is, I believe, always the result of accident. At the best a crow's nest is an unsafe nursery."

For the above reasons the koel does not appear to operate as a very powerful check on the increase of the corvine population in India.

The koel, it may be mentioned, belongs to a non-parasitic branch of the cuckoo family. I am inclined to believe that its parasitism has been developed independently of that of the other cuckoos, that this habit has been forced upon the koel by the behaviour of the crows. The koel used probably to build its own nest, as does the coucal (*Centropus sinensis*), but was so worried by the corvi that its nest used often not to be ready in time to receive the eggs, thus in self-defence the koel had to lay them in the nests of the crows, which had used in the construction of their nests some building material robbed from the nest of the koel.

Crow-Pheasant or Coucal—*Centropus sinensis*

This non-parasitic cuckoo seems not infrequently to devour the eggs and young of other birds. It is to some extent carnivorous and is very agile in trees. I have never caught this species in the act of robbing a nest, but other observers have.

Miss M. Cockburn states (*N. and E.*, II. 39) that the crow-pheasant often robbed of their young the white-spotted fantail flycatchers (*Rhipidura pectoralis*) that nested in the pear trees in her garden.

T. de Greyther (*B.*, XXVIII. 799) saw a crow-pheasant carry off a dove's egg, which it deposited on the lawn. De Greyther rescued the egg, but in vain, the cuckoo having dented it while carrying it.

S. L. Darling describes (*N. and E.*, II. 890) how he discovered a nest of the white-throated ground thrush

(*Geocichla cyanotus*) by the noise made by the birds in "defending their nest against those thieves of crow-pheasants."

Davidson strongly suspected (*N. and E.*, II. 157) that crow-pheasants were in part responsible for the enormous number of the nests of rain-quails (*Coturnix coromandelica*) which he found destroyed.

OTHER BIRDS

Birds of prey, owls and members of the crow family are the only fowls of the air which habitually prey upon their fellow-birds; a few species occasionally kill other birds or take their eggs.

The following have been observed to do so under natural conditions: Coots, the great bustard, gulls, herons, hornbills, the king-crow, kingfishers, mynas, rollers and shrikes.

It is not unlikely that some of the larger Indian non-raptorial birds are occasionally predatory, although no observations of this habit have been recorded. In this connection mention may be made of the fact that M. C. Nichol records (*A.M.*, July, 1906) that the sacred ibises (*Ibis æthiopica*) breeding on Dassen Island (Africa) do much damage to a rookery of cormorants. They kill the cormorants and devour their entrails. "This," writes Nichol, "sounds almost incredible, but it is apparently true, as all the young ibises, when first handled, disgorged a mass of entrails."

The following are all the observations I have come across of birds in India, other than raptorial birds,

owls, crows and cuckoos, taking birds or eggs. They do not include cases of destruction by birds in captivity.

The coot (*Fulica atra*) probably destroys a not inconsiderable number of eggs of birds which build floating nests. Sanyal states that the coots in the Zoological Gardens at Calcutta destroy other birds' eggs by sucking them, and he has known them treat their own eggs in this way.

Great Bustard (*Otis tarda*). E. C. Stuart Baker records (*B.*, XXI. 30) that this species eats the eggs of birds which nest on the ground. Elliot found (*H. and M.*, I. 9) an entire quail's egg in the stomach of a great bustard.

Gulls. Every species of gull will eat eggs and young birds whenever these offer, and so gulls tend to keep in check the population of terns and other birds which lay their eggs on the sand. Butler describes (*N. and E.*, III. 297) how on Astollah, an island off the Mekran coast, he witnessed Hemprich's gulls (*Larus hemprichi*) devouring the eggs of the large crested tern (*Sterna bergii*).

Herons. The larger herons sometimes prey upon other birds. I can find no record of their doing so in India, but the grey heron (*Ardea cinerea*) in England has been observed to do so. E. Kay Robinson writes (*Surrey Comet*, February 21st, 1925) that he has seen this heron seize "little rabbits and water voles, and, in one instance at least, a moor-hen."

Hornbills. Hornbills subsist mainly on fruit, but they are to some extent carnivorous. They often eat bees. A. M. Primrose says of a Indo-Burmese pied

hornbill (*Anthracoceros albirostris*) in captivity: "Of birds I have observed him catch the swallow and make a bag of four munias, the former were caught as they passed him while seated on a dead branch and, after being beaten about for a time, were gulped *holus-bolus*, 'fur, feet and feather' with great gusto."

A. Newnham saw (*B.*, XXI. 264) a grey hornbill (*Lophoceros birostris*) pulling young paroquets out of a hole and devouring them. H. Whistler noticed (*B.N.*, October, 1914, p. 341) the same species taking something from a hole, and, judging by the fuss a pair of mynas were making, that "something" appears to have been a myna's egg or nestling.

King-Crow. B. B. Osmaston records seeing a king-crow (*Dicrurus ater*) carrying a white-eye (*Zosterops palpebrosa*) in its claws.

Kingfishers. In Australia some species of kingfisher prey largely on young birds. This is not the case with kingfishers in India, as they, with the exception of the Halcyons, feed almost entirely on fish. E. C. Stuart Baker, however, once saw (*B.*, X. 541) a stork-billed kingfisher (*Pelargopsis gurial*) take a myna nestling (*Acridotheres tristis*) from a nest in a tree, despite the mobbing of the parent birds. W. F. Biscoe on one occasion noticed (*B.*, XIII. 184) a white-breasted kingfisher (*Halcyon smyrnensis*) with a bird in its bill, on another he saw this kingfisher attack a small bird, which, however, escaped with the loss of some feathers.

Rollers. K. C. Macdonald saw (*B.*, XVII. 193) a roller (*Coracias affinis*) devouring a young bulbul.

Shrikes. The various species of shrikes, particularly the larger ones, occasionally kill adult birds and more frequently nestlings.

H. A. F. Màgrath and H. Delmé Radcliffe have recorded the destruction of young sparrows by the rufous-backed shrike (*Lanius erythronotus*). Magrath points out that this species takes heavy toll of young sparrows on the Kashmir Road. He further records that he saw one of these shrikes capture an adult sparrow among those roosting in a creeper growing over the porch of the Nowshera Club. The shrike carried the sparrow to a perch and there devoured it. The same observer once saw (*B.*, XX. 228) a rufous-backed shrike rifle the nest of a purple sunbird (*Arachnechthra asiatica*). E. O'Brien observed (*B.*, XXVI. 667) a grey shrike (*L. lahtora*) attack a wounded sand-grouse.

Some species of non-raptorial birds tend to check the growth of the population of their fellow-species by methods other than preying on them or their eggs or young. We have already noticed how they compete for nesting sites. They also compete for food, and the males in some cases fight one another, particularly at the breeding season.

The sparrow (*Passer domesticus*) is a not unimportant check on the population of swallows and martins. B. Aitken says (*N. and E.*, II. 193) of the Indian cliff-swallow (*Hirundo fluvicola*): "They are much persecuted by sparrows, who take possession of the egg-cup of the nest before the neck is added, and a single pair will cause several nests to be deserted before they suit

themselves." He writes (*N. and E.*, II. 182) of the dusky crag martin (*Ptyonoprogne concolor*): "They are persecuted while building and occasionally driven away by sparrows; but, their open nest not being adapted to the wants of these birds, they do not take possession of it."

Miss Cockburn states (*N. and E.*, II. 143) that sparrows often appropriate the nests of spotted munias (*Uroloncha punctulata*): the sparrows wait until a nest is completed and then drive off the rightful owners and proceed to line it with feathers.

Sometimes the persecuted birds turn upon their adversaries. "Many years ago," writes Miss Cockburn (*N. and E.*, II. 187), "I remember watching for some days a battle between a cock sparrow and a pair of house-swallows (*Hirundo javanica*). The latter had finished their nest in our verandah, when the sparrow discovered it, and never left it except for the purpose of satisfying his appetite. The poor swallows saw that they could do nothing, so they disappeared and told their friends in swallow language: and, as in the multitude of councillors there is wisdom, some time after, to our surprise, we saw a great number of house-swallows, each with a wee lump of clay in its bill. They flew up to the nest, and succeeded in building up the sides, the sparrow inside doing its utmost to stop their work; but they, being accomplished artizans in their own masonry, did not take a second to fix each piece of clay. It became a most exciting scene, and we fully expected the sparrow would have been imprisoned for life, but, no, he was much too crafty

to allow that. With one effort he burst through the very small hole that was unclosed and escaped, being attacked by all the swallows at the same instant. Thus the conflict ended by the rightful owners having possession of their nest."

This sounds rather like romance, but it receives some confirmation from Davidson's account (*N. and E.*, II. 200) of how Sykes' striated swallows (*H. erythropygia*) walled in one of their own kind. "After examining a few of the nests," he writes, "I came to one which had the tubular entrance walled up, and the mud perfectly hard and dry. On breaking away a part of the nest, I found a dead bird in it, which had come quite to the small end of the tubular neck and had there died: the nest contained three old eggs, of which the contents had partially dried up. I can only account for this bricking, or, I should say, walling up of the entrance to the nest by supposing that some of these other birds had coveted and failed to obtain this site for their nests. It is only natural to suppose that more than one pair were concerned in the business, as it would have taken at least one bird to keep the bird from leaving its nest, and another to keep its mate away from the nest, and probably another or several pairs to close the entrance."

Next to the sparrow the mynas are the greatest causers of annoyance to small birds at the nesting season. I once saw at Lahore a common myna (*Acridotheres tristis*) come to some sparrow nestlings in my possession and begin to peck at one of them. I have recorded (*Glimpses of Indian Birds*, p. 67) how mynas

destroyed a robin's nest in my verandah at Fyzabad. O. C. Ollenbach witnessed (*B.*, XXVIII. 802) mynas driving a pair of magpie-robins (*Copsychus saularis*) from a nest containing two eggs.

H. Littledale records (*B.*, I. 33) how mynas destroyed in succession three nests of a pair of paradise flycatchers (*Terpsiphone paradisi*).

R. M. Betham records (*B.*, XII. 775) a case of brahminy mynas (*Temenuchus pagodarium*) ejecting grey tits (*Parus atriceps*) from a hole in a babul tree.

N. F. Troup reports (*B.*, XII. 771) swifts ejecting red-rumped swallows from a nest.

We know that in aviaries birds often prove very pugnacious and that many are killed in fights. Such contests are, however, conducted in, and many are doubtless due to, unnatural conditions. In nature severe fights appear to occur only during the pairing season, when males become very pugnacious.

Some species are far more quarrelsome than others. The males of all polygamous species are pugnacious, and many of these lose their lives in fights with others of their kind.

Some monogamous species are addicted to fighting, particularly bulbuls and sunbirds. The former, like quail and partridges, are kept by Indians for fighting purposes.

There are not on record many instances of wild birds being killed in fights with others of their own species. The reason for this is, not that such deaths are uncommon, but that they are not witnessed,

because fighting birds, when disturbed by a human being, usually break off and fly away.

One of the most pugnacious species is the Burmese peacock (*Pavo muticus*). The males frequently kill one another. One of them will sometimes attack and kill a female. Jungle cocks, especially the Ceylon jungle fowl (*Gallus lafayetti*) and the red species (*G. bankiva*) fight like game cocks. E. C. Stuart Baker records (*B.*, XXV. 14) finding a dead jungle cock (*bankiva*) beside another so weak that it made no attempt to escape. A. O. Hume had one of these birds brought to him in splendid plumage, but having the base of the skull on one side pierced by what seemed to be the spur of another cock. Nor are these fights confined to males of the same species; Stuart Baker witnessed (*B.*, XXV. 14) a fight between a red jungle cock and a male black-backed kalij pheasant (*Gennæus melanonotus*), in which the latter was killed, while the jungle cock was almost unharmed except for a broken spur and a torn comb.

Jungle cocks become so engrossed when fighting that Indians sometimes catch them by merely throwing a cloth over two fighting birds.

In the case of polygamous species the unmated cocks probably often exercise an injurious effect on the breeding operations of the species by molesting incubating hens.

The only records of which I am aware of birds, other than gallinaceous and game birds, killing one another in natural conditions in India are those of green bulbuls (*Chloropsis aurifrons*).

E. C. Stuart Baker cites (*B.*, VIII. 10) two instances witnessed by him of these birds killing one another in a fight. Instances among captive birds are, of course, common. One unexpected case which came to my notice was that of a white-eye (*Zosterops palbebrosa*) which had been kept for some time in one of the aviaries in the Zoological Gardens at Lahore. In order that he might have a companion of his own species a second white-eye was placed in the cage. Within a few hours of its arrival the new-comer was killed by the other white-eye.

In captivity, however, birds live in artificial conditions, and often conduct themselves in unusual manner. Thus S. C. Low relates (*B.*, XXIX. 1058) that a cock magpie-robin (*Copsychus saularis*) in his aviary killed some bulbul nestlings.

MAMMALS, OTHER THAN MAN

Of the many enemies against which birds have to contend the mammals are not the least. The rodents are particularly destructive to birds, and probably constitute quite as effective a check to the growth of the avian population as the birds of prey.

Bats

Vampire bats (*Megaderma*), and possibly other species, prey upon small birds. As regards the Indian vampire bat (*Megaderma lyra*) there is no lack of evidence that it is destructive to small birds.

E. E. Green, writing from Ceylon, states (*B.*, XVII. 835) that he suspects that bats of the genus Megaderma devour small birds. He often found in the morning remains of such (principally white-eyes, sunbirds and flower-peckers) that had been eaten during the night. "The destruction of small birds by these nocturnal assassins," he writes, "is considerable. I have gathered up the wings and feathers of three or four birds each morning for several months in succession in a single room. The bat (if bat it is) must systematically search bushes in which the birds roost."

A. M. Primrose actually witnessed (*B.*, XVII. 1021) an Indian vampire bat eating a small bird. He thus obtained confirmation of what he had long suspected, namely, that this bat eats several kinds of small birds, chiefly Indian bush-chats (*Pratincola maura*).

F. Gleadow writes (*B.*, XVII. 1022): "*Megaderma lyra* habitually feeds on birds and mice. These verminiferous vermin (bats) used to annoy me greatly by catching mice about my house, and fetching birds out of their comfortable nests at night and chawing them up in the corners of rooms or verandahs. We were spared the use of our inductive and deductive faculties (which would perfectly suffice) by the simple fact that I have seen them do it many times. The well-known zoologist, Mr. F. Finn, was living with me at the time. We caught and caged the bats and he fed them on small birds brought for sale by the natives. The hanging bat watched his time, made a grab, had the bird by the back of the neck and killed it instantly. No chase or excitement, simply a swoop or even a

grab with the wings when the bird passed close enough. Having got the bird by the neck close behind the head, the hanging bat made a clean job of it in a wonderful fashion. He started by chewing the neck in two and dropping the head as neatly as anyone could do with two hands and a knife and fork. Never by any chance did he drop the body, though the wings were not used for holding it. Wings were occasionally used for turning the body round by a mere touch, but never for supporting it. He chewed steadily along to the feet and tail, which dropped in their turn with the same matter-of-course facility."

E. H. Aitken states (*B.*, XVIII. 190) that he used to feed an Indian vampire bat on sparrows. According to this observer the head was the first part of the bird which his bat used to eat. "Their jaws and teeth," writes Aitken, "must be comparable to those of a hyæna. . . . They catch the birds, of course, off their roosting places. They may often be seen flitting about trees after dusk manifestly on this quest."

H. H. Harington records (*B.*, XXIII. 157) that the Burmese swifts (*Micropus pacificus*) which breed in the Gotuk caves are victimized by bats, but he does not say to which genus these bats belong. He picked up a number of eggs which clearly had been sucked by the bats that swarm in those caves.

Bears

Bears subsist almost entirely on fruit, insects and honey, but Tickell asserts that the Indian sloth bear

(*Melursus ursinus*) occasionally takes waterfowl and their eggs. It would thus seem that this species, at any rate, must be included among the enemies against which birds in India have to contend.

Canidæ

The Indian Fox (*Vulpes bengalensis*). Jerdon saw this species hunting quail. It doubtless kills many young birds and eats eggs.

The Indian Desert Fox (*V. leucopus*). This fox seems to be destructive to birds and their young and eggs. C. B. Ticehurst noticed (*B.*, XXVIII. 799) the "spoor" of this creature among a colony of nesting Saunder's terns (*Sterna saundersi*).

The Himalayan Fox (*V. alopex*). This fox is very destructive to partridges, pheasants and other game birds. It often carries off poultry.

The Jackal (*Canis aureus*). The jackal, although essentially a scavenger, doubtless takes birds, old and young, and eggs whenever an opportunity occurs.

The Indian Wolf (*Canis pallipes*). The wolf does not appear habitually to take birds, but doubtless does so occasionally.

Felidæ

The Tiger (*Felis tigris*). The tiger is not above taking a peafowl when no better quarry offers, and it does not hesitate to slay a vulture which it finds feeding on its "kill."

The Leopard (*Felis pardus*). The leopard, being smaller and able to climb trees with ease, is far more destructive to birds than is the tiger. A leopard will take anything from an ox to a sparrow. It kills numbers of peafowl; in jungles infested by leopards remains of these birds may often be seen.

The Clouded Leopard (*Felis unica*). This beast inhabits trees and feeds largely on birds.

The Jungle Cat (*Felis chaus*). This and all the other wild cats, as well as domestic cats, prey largely on birds. Wild cats are very destructive to peafowl, game and other birds. Jerdon and McMaster record how they were robbed by the jungle cat of peafowl they had wounded. C. M. Inglis states (*B.*, XVIII. 287) that a jungle cat got into his aviary and killed some young swamp partridges (*Francolinus gularis*).

In villages and towns the domestic cats, of course, do much damage to birds.

The Caracal (*Felis caracal*). This is destructive to birds.

The Lynx (*Felis lynx*). This species often captures birds.

Martens

All the martens are destructive to birds. C. H. Donald records (*B.*, XIV. 175) that the pine marten (*Mustela foina*) is an adept at climbing trees and watches for opportunities to take birds when they go to roost. The Indian marten (*M. flavigula*) lives largely on birds and their eggs, as does the Indian

ratel (*Mellivora indica*). The last is very destructive to poultry.

Monkeys

The monkey tribe is the cause of much destruction to birds' eggs and even to young birds. King-crows (*Dicrurus ater*) habitually mob monkeys. Probably every species of *Macacus* and *Semnopithecus* (Langur) rob nests. The Bengal monkey (*Macacus rhesus*), being the most abundant, is probably the most destructive to birds. Littledale records (*B.*, I. 33) that he witnessed a monkey of this species destroy the nest of a large cuckoo shrike (*Graucalus macii*). F. Field saw (*B.*, XXVIII. 755) one rob the nest of a crow-billed drongo (*Dicrurus annectens*) though savagely attacked by the bird. H. A. F. Magrath states (*B.*, XIX. 149) that this monkey destroys many eggs and young of the grey-headed and grey-winged ouzels (*Merula castanea* and *M. boulboul*).

The hoolock or white-browed gibbon (*Hylobates hoolock*) eats birds, both old and young, and eggs. Anderson found that small birds were killed (Blanford, *Mammalia*, p. 7) by hoolocks in confinement with a method and eagerness that showed this prey to be the natural food of these apes.

Martin (*Man and Monkeys*, p. 430) describes how an allied species, not found in India, catches birds on the wing.

The slender loris (*Loris gracilis*) and the slow loris (*Nycticebus tardigradus*) eat eggs and young birds.

Otters

Although no one seems to have caught an otter in the act of killing a bird or devouring eggs, there seems to be little doubt that they occasionally do so. Doig records that at Narra, in Sind, he came upon a nest containing ten incubated eggs of the spotted-bill duck (*Anas pœcilorhyncha*). These, with the exception of one, were scattered and broken. Before reaching the island on which the nest was placed, he noticed a family of otters playing, which decamped at his approach. He has no doubt that these were the culprits concerned in the pillage of the nest.

Although they feed chiefly on fish, frogs and crustacea, otters probably do some damage to the eggs and young of birds which nest on the ground near water.

Rodents

Some of the rodents are very serious checks to the growth of the bird population in India.

The brown rat (*Mus decumanus*) is almost as destructive as the house-crow (*Corvus splendens*) to eggs and nestlings. It is a curse to aviculturalists. As it takes chickens, domesticated pigeons, and adult birds in aviaries, it almost certainly kills adult wild birds when these are roosting. This rat is appallingly abundant in India. Everywhere it lives up to the margin of subsistence. Its depredations are not confined to birds which nest on the ground. H. Stevens states (*B.*, XXX. 59) that the common mynas (*Acri-*

dotheres tristis) at Darjeeling suffer so greatly from rats that they have learned by experience to select the most suitable of the limited nesting sites available.

The depredations of the brown rat are confined mainly to the vicinity of towns and villages. Birds, at a distance from human habitations, are comparatively immune from the attacks of rats, but they have to contend against tree- and field-mice.

C. M. Inglis records (*B.*, XIV. 362) that on several occasions he has caught the long-tailed tree-mouse (*Vandeleuria oleracea*) in the nests of the black-throated weaver-bird (*Ploceus bengalensis*), and that this mouse destroys many of the eggs of those birds.

This is the only instance that I have found of mice being caught *flagrante delicto*. Further observation will certainly yield a great many more cases of this kind. Wenden writes (*H. and M.*, II. 156): "I noticed many nests in which the eggs of quail have been destroyed by snakes, lizards or field-mice, most probably the latter, I think." Every aviculturalist knows how destructive mice are in the aviary. The nocturnal habits of mice and rats explain why these pests are so rarely seen at work.

Ruminants

Although cattle, deer and other ruminants never eat birds or their eggs, they must be included among the enemies of the feathered folk in India because of the destruction they cause, in localities where they are numerous, to nests, eggs and young by treading

on these. Moreover, they must sometimes damage nests by pulling at branches when browsing.

Lindsay Smith states that on two occasions he came upon woodcocks' nests in which the eggs had been broken by cattle.

Some years ago P. H. Clutterbuck told me that he saw an incubating sarus crane (*Grus antigone*) stand up in her nest and flap her wings in order to prevent some village buffaloes from walking over it.

Some incubating birds sit so closely that they get trampled under foot by cattle. C. H. Donald states that he once trod upon an incubating quail (*Coturnix communis*).

Squirrels

Squirrels must be numbered among the enemies of birds. C. Coward records (*Magazine of Natural History*, 1839, p. 311) that he, while cleaning out a cage of young kingfishers, left the birds on a table in a room where three half-grown squirrels were allowed to play. On his return he found one of the squirrels busily employed in plucking the feathers from the head of one of these birds, which it had killed. The following day a young cuckoo was placed in the same situation, when it was quickly attacked by a squirrel, which seized it under the wing, and so destroyed it; it afterwards began to feed upon it, and the two other squirrels joined in the feast. Several times was the experiment tried both with dead and living birds, and it was invariably found that the squirrels would forsake their vegetable food for the more agreeable animal

diet. The writer adds: "I was then residing in the heart of Wiltshire; and on mentioning the fact to the shepherds, who are frequently keen observers of the habits of wild animals, I found that it was by no means uncommon for the squirrels to be seen in the act of devouring young birds, particularly in the copses that intersect the bleak downs of Wiltshire. Indeed, one shepherd assured me that one evening in autumn he observed a severe struggle between a wood-pigeon and a squirrel among the branches of a tree, and that the latter proved victorious, and began to feed upon his victim. I have bred upwards of a dozen squirrels taken when a few days old, and in nearly every case have observed the fact of their relish for animal food."

Every Londoner is aware that the American grey squirrels, which have been introduced into Regent's Park and other places, have caused an appreciable diminution in the numbers of small birds in such areas.

There are no records of squirrels eating birds in India, and those of their taking eggs are few. Tickell states that the large Malay squirrel (*Sciurus bicolor*) eats birds' eggs. There is some evidence that the common and ubiquitous palm squirrel (*S. palmarum*) does likewise. Brown-backed robins (*Thamnobia cambayensis*) are often seen mobbing this squirrel, and from this it may be inferred that it attacks their nests. Whether or not it eats eggs, there is no doubt that it does much damage to weaver-birds' nests (*Ploceus*) by cutting these down, probably with the object of using the material

for its own drey. Both Barnes (*B.*, II. 105) and Horne (*N. and E.*, II. 108) record this habit.

At Madras a palm squirrel came into my house and gutted a *sola topi* (sun helmet) in order to provide building material for its nest!

Mrs. G. A. Wathen informs me that one spring there was much fighting between paroquets, rollers and a palm squirrel over a hole in the wall of her house at Amritsar. All wanted to nest in it. The rollers were victorious.

Suidæ

The pig family may do damage occasionally by trampling under foot nests. The pigmy hog (*Sus salvanius*) is said to eat birds' eggs.

Viverridæ

The common Indian mungoose (*Herpestes mungo*) works more destruction to birds and their young and eggs than does any other mammal except the brown rat. We know that this creature, since its introduction into Jamaica, has wiped out several species of birds which nest on the ground. It has also caused the Fijian lory (*Calliptellus solitarius*) to become extinct in some of the Fiji islands.

The Indian mungoose hunts systematically for the eggs of partridges, quails and other birds which lay on the ground. It sometimes devours birds; a quail was found in the stomach of a mungoose killed near Secunderabad.

F. Field states (*B.*, XXVIII. 767) that the mungoose is very destructive to the eggs of black partridges.

T. B. Bell found (*B.*, XIV. 394) many nests of the banded crake (*Rallina superciliaris*) robbed of their contents by mungooses.

"Fleur de Lys" records (*The Field*, 2nd February, 1908) that mungooses got into a quail pit and killed large numbers of quail; they behave in the same way to canaries in a cage. A mungoose used to visit daily a cage of amadavats (*Sporæginthus amandava*) kept by me at Lahore. When it found that it was impossible to get at the birds, it took to eating the seed. Its boldness was astonishing; it would return to the cage a few minutes after it had been chased away.

Most species of civet cats take birds and their eggs. Jerdon kept tame civets (*Viverricula malaccensis*) which used to catch sparrows and other birds.

According to J. M. Paterson (*B.N.*, October, 1912, p. 272) an enemy of small birds is "the small fruit-bear, a kind of civet cat, which comes to the fruit trees and takes its fill at night time and eats any eggs it may come across." Paterson does not give the scientific name of the creature to which he refers.

The spotted tiger-cat (*Prionodon particolor*) is said by Hodgson to prey chiefly on small birds, upon which it is wont to pounce from the cover of the grass.

Snakes

Snakes operate as an effective check on the growth of the avian population of India, inasmuch as they eat

birds and their eggs. Some species are far more destructive than others; indeed, a few may never take birds or their eggs.

Several observers, who have witnessed snakes attacking birds or eggs, have not been able to determine the species of snake. Thus F. Kingdon Ward records (*B.*, XXVII. 755) a snake—black with yellow rings—sucking the eggs of a small bird having a nest in the grass.

J. Davidson once saw (*B.*, XII. 44) a snake coming out of the nest-hole of a bee-eater (*Merops athertoni*). This observer states that snakes are partial to that particular species.

C. M. Inglis says (*B.*, XIV. 764) that either snakes or magpies destroy a large number of the eggs of the white-breasted water-hen (*Amaurornis phœnicurus*).

J. Manners Smith noticed (*B.*, XVI. 507) peewits mobbing a snake which had eaten two eggs and was in the act of swallowing a third when he came upon the scene.

Apart from observations of actual attacks by snakes, the fact that mynas, babblers and other birds always become very excited at the presence of a snake and mob the reptile affords evidence that snakes are enemies of birds.

The following snakes have been observed feeding on wild birds or their eggs:

Cobra—*Naia.*
Brown Tree Snake—*Dipsas trigonota.*
Rat Snake—*Zamenis mucosus.*

Python—*Python molurus.*
Earth Snake—*Eryx conicus.*
Pit Viper—*Lachesis graminius.*
Green Whip Snake—*Dryophia mycterizans.*
Bronze-backed Tree Snake—*Dendrelaphis tristis*, and probably the
Golden Tree Snake—*Chrysopelia ornata.*

Cobra. Many of the quail in my quail house at Pilibhit fell victims to a cobra which used to raid the place at night.

E. B. Fox records (*B.*, XVI. 369) that a cobra ate six out of thirteen guinea-fowls' eggs. The eggs that had been swallowed were taken out of the snake and set : one of them yielded a chick.

C. P. George writes (*B.*, XVI. 174) that a cobra swallowed two eggs which a guinea-fowl was incubating. These eggs were recovered, and from one of them a chick emerged.

Brown Tree Snake. One of this species attacked a nest of bulbuls (*Otocompsa emeria*) in the verandah of my bungalow at Fyzabad. I was absent at the time. The bulbuls made so much fuss as to attract the notice of a servant, who killed the snake. In the fracas the three eggs which were in the nest fell out.

W. S. Millard states (*B.*, XVIII. 594) that in captivity this species feeds largely on small birds, lizards, etc., killing them by constriction as a python does.

Rat Snake. F. W. Venning records (*B.*, XXI. 691) that a rat snake seized a snipe he had shot.

F. Wall saw (*B.*, XVII. 266) one of these snakes

attacking a nest of young birds at Fyzabad. It had devoured a nestling before he could kill it.

Python. The Indian python often takes poultry, chickens and domestic ducks.

Thwaites (*The Field*, 21st December, 1907) once saw a peacock in the toils of a python.

G. H. Evans witnessed (*B.*, XVI. 520) in Burma a python eating a pheasant (*Gennæus lineatus*).

P. R. Caddell found (*B.*, XXII. 203) inside a python six wild ducks, including a gadwall and a pintail. All six appear to have been swallowed at the same time; they were probably birds that had been killed or wounded by sportsmen.

Earth Snake. G. A. Levett-Yeats records (*B.*, XXIII. 371) seeing this snake devouring a myna (*Acridotheres tristis*). The snake, when he saw it, had coiled itself round the body of the bird and was gripping the breast with its jaw. At the time one-third of the snake's body was in its hole. The same observer on other occasions caught this snake killing a hoopoe (*Upupa epops*) and a babbler (*Crateropus canorus*).

Indian Bronze-backed Tree Snake. F. Wall states (*B.*, XIX. 783) that at Colombo he saw this snake attacking the eggs of the black-backed robin (*Thamnobia fulicata*). The birds were mobbing the snake when Wall came upon the scene.

Crocodiles

Crocodiles seem but rarely to take birds. I can find no record of their eating eggs. They certainly do not

operate as an appreciable check on the growth of the avian population of India.

H. W. Forsyth found (*B.*, XX. 228) the remains of a bird in the stomach of a garial (*Gavialis gangeticus*). The crocodile may have come upon the bird when the latter was dead.

I remember reading somewhere, but am unable to give the reference, that a crocodile (*Crocodilus palustris*) was seen to seize a peacock.

Batrachia

The only species of frog which seems to kill birds is the bull frog (*Rana tigrina*). This formidable batrachian occasionally surprises birds and swallows them whole. E. H. Aitken once found (*B.*, XI. 500) a full-grown sparrow inside one of these frogs. He states that on at least three occasions he has known a bull frog try to swallow a chicken at least a week old.

J. A. Betham saw (*B.*, X. 695) a bull frog swallowing a chicken, and on one occasion took from the jaws of this frog a pitta (*Pitta brachyura*).

Lizards

Although there are but few records of lizards taking eggs or nestlings, there can be little doubt that some species eat numbers of eggs of wild birds. As lizards are very abundant in India, they are probably an appreciable check on the growth of the avian population.

Several observers record attacks by lizards on birds' eggs without naming the species of the attacker. Thus G. Vidal, writing of a pair of nesting munias (*Uroloncha malabarica*) says (*N. and E.*, II. 141): "I got one bird, and while I was waiting for the other to return, a lizard got into the nest, and, within two minutes, succeeded in destroying three of the eggs, breaking two and making away with the third."

T. de Greyther (*B.*, XXVIII. 799) saw a lizard leaving the nest of a bird (species unknown), and on inspecting the nest he found that the contents of the eggs had been eaten, the shells being left.

J. M. Paterson records (*B.N.*, October, 1912) finding a lizard, which he styles a *gohara*, in the nest of a magpie-robin (*Copsychus saularis*). The lizard had eaten the eggs.

Monitor Lizard (*Varanus bengalensis*). C. M. Inglis records (*B.*, XVIII. 287) that a monitor lizard got into his aviary and killed some young swamp partridges (*Francolinus gularis*).

O. C. Ollenbach once saw (*B.*, XXVIII. 800) one of these lizards swallow an unfledged sunbird (*Arachnechthra asiatica*).

E. C. Gill records (*B.*, XXIX. 303) having seen the monitor lizard robbing nests on several occasions, usually in the vicinity of water.

Bloodsucker Lizard (*Calotes versicolor*). A. Anderson saw (*N. and E.*, II. 73) this lizard devouring the eggs of the brown-backed robin (*Thamnobia cambayensis*).

Gecko (*Hemidactylus gleadovii*). B. Aitken states (*N. and E.*, II. 275) that he placed an egg of a flower-

pecker (*Diæcium erythrorhynchum*) on a wall out of reach of rats, but within reach of a gecko (house lizard) which destroyed the egg in the night.

Fish

In England some fish, particularly the perch and, to a lesser extent, trout, eat the young of little grebes (*Podiceps albipennis*) and of other birds which build floating nests.

C. Barnby Smith states (*A.M.*, December, 1901, p. 59) that he caught on a fly in Iceland a four-pound trout that had previously swallowed two eider ducks.

Young water birds probably fall victims to fish in India. I have, however, not come upon any recorded case of this.

Crustacea

Hermit crabs are very destructive to the eggs of terns and other birds which lay on the sand. E. R. Shopland states (*N. and E.*, III. 299) that on Oyster Island, near Akyab, hermit crabs take the eggs of the large crested tern (*Sterna bergi*) whenever an opportunity occurs.

Other species of crab doubtless attack eggs when they find them unprotected. A species of burrowing crab is very abundant along the seashore at Madras. These crabs are a positive nuisance to golfers on the island links at Madras, because they frequently seize a golf ball and disappear with it into their burrow before the driver of the ball can come up; they presumably mistake golf balls for eggs.

Insects

The only kinds of insects which appear to destroy birds or eggs are termites, ants and mantises.

Termites, or white-ants as they are commonly called, destroy a goodly number of nests by enclosing them in their galleries.

H. Whistler writes (*B.N.*, October, 1914, p. 343): "Ants appear to play a great part in the destruction of eggs in this (Jhelum, Punjab) district, and it is a common sight to see an old nest encased with the mud galleries of a colony of white-ants, who are very busy consumers of the materials of which it is made."

A. L. Butler, in Ceylon, came upon (*B.*, X. 306) a pair of white-throated wren-babblers (*Dumetia albigularis*) building a nest in long grass; when he visited this eight days later he found it replaced by a fresh white-ant hill. Kicking this open, he found that the termites had used the globular mass of grass as a foundation and embedded the ill-fated nest in a cone of earth two feet high.

As regards ants proper, in the course of a residence of some twenty years in India I have never come across an instance of their preying upon eggs or nestlings. I have frequently found them eating the contents of eggs in a nest, but I always assumed that the eggs in question had been broken before they attracted the ants.

The fact that birds sometimes build nests in trees which swarm with red ants would seem to militate against the supposition that ants attack living nestlings

or unbroken eggs. Moreover, woodpeckers of the genus *Micropternus* lay their eggs in holes made in ants' nests attached to trees. The plumage of these birds is often smeared with a gummy substance derived from ants' nests, and heads of ants have been found sticking to their feathers. These woodpeckers, however, are in many ways peculiar. They feed largely on ants and emit a curious scent. Thus, because they (and apparently their young and eggs) appear to be immune from the attacks of ants, it does not follow that all kinds of birds are.

There is direct evidence that ants do sometimes attack birds and their eggs. Burnett records (*B.*, XVII. 886) that an egg of the Indian plaintive cuckoo (*Cacomantis passerinus*) which he had taken was eaten by ants.

Brooks writes (*N. and E.*, II. 122) of the striated weaver-bird (*Ploceus manyar*): "I found a nest . . . a former nest had been built and abandoned as a colony of black ants had taken possession of it."

Further, we have the evidence of no less an authority than C. Barrett that in Australia ants devour the nestlings of small birds. W. H. Hudson in his *Book of a Naturalist*, quotes Barrett as writing: "I believe that in Australia, where ants of many species swarm in dry regions, large numbers of nestlings fall victims to these insects. Of course, it is the birds that nest on the ground that suffer the most, but some of the ants ascend trees and attack the fledglings in nests in the highest branches. . . . In November I noticed a stream of large reddish ants swarming up a green

sapling, and found it was pouring into a nest of wood swallows (*Artamus sarolida*), which contained three chicks about a week old. They were being devoured alive by ants. . . . I put the nestlings out of their misery."

Barrett further records that he came across a thrush's nest with nestlings in a similar state.

As regards birds in England, W. H. Hudson writes: "I have said to myself a hundred times that birds, especially the small woodland species that nest on or near the ground, such as the nightingale, robin, wren, chiff-chaff, wood and willow wrens and tits, must occasionally have their nestlings destroyed by ants; yet I have never found a nest showing plainly that such an accident had occurred, nor have I seen anything on the subject in books about birds, and of such books I have read hundreds."

Hudson in England and I in India wrote to the Press asking whether anyone had come upon cases of nestlings or intact eggs being attacked by ants. Hudson's letter resulted in reports of nestlings of the wren and the skylark being destroyed by ants. The letter I wrote elicited no information on the subject.

Ants literally swarm in all the warmer parts of India, so that, if they habitually attack healthy eggs and nestlings, they must be a powerful check on the avian population. I can hardly believe this to be the case, but the matter is certainly one that requires investigation.

The only record which I have come across of a mantis killing a bird is that of C. A. R. Brown (*B.*,

XII. 578). This observer saw a mantis strike out with its forelegs and scalp and kill a sunbird (*Arachnechthra minima*).

Spiders

The mygale spiders take birds at night. A. W. Morris records (*B.*, IV. 70) that *Mygale fasciata* captured and devoured a martin (*Ptyonoprogne concolor*) in the Shevaroy Hills.

MAN

Of the influences which have affected the birds of India, one of the greatest is that of man. There can be little doubt that had no human being set foot in the country, the avian population would have been very different in character and numbers to what it is.

The presence of human beings in a country affects the population of birds in many ways.

Some of the acts of man which affect birds are deliberate efforts either to destroy them, as when he shoots or snares them, or to preserve them, as when he makes laws enforcing a close season or encourages them by putting out food for them. Other acts of man are unintentional in the sense that when performing them man gives no thought to the fact that they are affecting certain species of birds. Examples of this class of act are clearing forests, taking land into cultivation and constructing canals.

Let us first consider this class of acts.

When India was thinly populated the country was to a considerable extent covered with forest. Man

has cleared many square miles of woodland, and one effect of this has been to diminish the population of birds which are confined to forests.

E. C. Stuart Baker points out (*B.*, XXIII. 663) how the acts of man have caused kalij pheasants (*Gennæus*) to split up into several races. "In the Shan States," he writes, "man has proved an additional factor in the differentiation of form. He has cultivated highlands which were originally under forest, but has deserted this cultivation and left behind him wide extents of grass. In some cases he has thus adapted the country to such birds as seek the open, and in others he has driven the forest-loving birds into villages and pockets so small that the surrounding forms are gradually, by constant hybridization, exterminating all signs of their origin."

By clearing and cultivating forest land, man has not only diminished the numbers of some species of woodpeckers, hornbills and other forest-haunting birds, but, by providing abundance of food for grain-eating birds, such as sparrows, has increased the population of these.

Similarly man, by taking grass land into cultivation, has diminished the numbers of birds that affect such land. Of such is the pretty little black-winged kite (*Elanus cærulus*). Owing to the presence of man this species is tending to diminish in numbers. J. Davidson points out (*N. and E.*, III. 179) the effect of drought on this kite in the Sholapur district. "The bird," he writes, "used to be a rare one in the district, but since the famine a very great deal of land has returned

to its pristine condition, and this little kite is now the commonest bird of prey." Here we have an instance of the effect of man being reversed by drought.

Man has unwittingly, by the construction of canals, greatly increased the numbers of grain-eating birds, which levy toll of the crops produced with the help of canal water. Nor is this the only effect of canals on the avian population. Canals, by drawing off water from rivers, have caused an increase in the number of islands that form during the winter in these rivers, thus the terns, pratincoles, etc., have now a far greater area than formerly in which to nest.

Most parts of the plains of India are now studded with hamlets, and these have resulted in an increase in the numbers of sparrows, crows, pigeons, doves, etc.

The springing up of a large town transforms the avian population of an area; kites, vultures, crows, sparrows, mynas and other species increase at the expense of nightjars, grass-owls, larks, red munias, etc.

Small birds which nest in holes probably benefit on the balance by the advent of man, since the buildings he erects afford them numerous nesting sites.

The plantation of mango topes and orchards tends to increase the numbers of paroquets, orioles, barbets, and, indeed, of most fruit-eating species.

Man, by setting fire to long grass and to the forests, causes every year much destruction to birds and their eggs and young.

C. M. Inglis records that large numbers of bush-quail (*Microperdix inglisi*) are destroyed by the fierce

grass fires that rage in the Goalpara District, Assam, during the early part of the year.

On one occasion in the Pilibhit District, U.P., I came upon a nest of a jungle fowl (*Gallus bankiva*), containing five eggs, which had been deserted on account of fire. The grass all round the nest had been burned.

A. L. Butler states (*B.*, X. 288) that in Ceylon the cultivators during the dry weather burn off the open *patuas* to produce a supply of young grass for their cattle. These fires cause "inestimable havoc" to the nests and young of partridges, quail and other birds which nest in the grass.

A. E. Osmaston writes (*B.*, XXVIII. 158): "I have often wondered why the cheer pheasant (*Catreus wallichi*) should not have become more numerous. I am inclined to the belief that annual forest fires, which generally occur just about the time when these birds are breeding, must be the principal check to their further increase, and I believe that this fine pheasant will become very much more plentiful now that large areas of chir pine forest are yearly closed by the Forest Department to enable the forests to be successfully regenerated."

The above remarks are, of course, applicable to other species which breed in the forests during the season in which fires occur.

C. W. J. Taylor describes (*N. and E.*, III. 55) how he once found a dead female roller (*Coracias indica*) resting on eggs in a hole in a partially burnt tree in a Mysore jungle where there had been a fire.

Among many others, the following species seem to have become more numerous in India owing to the indirect agency of man: Crows, sparrows, mynas, pigeons, doves, kites, scavenger vultures, terns, gulls, pratincoles, rosy starlings, buntings, paroquets, barbets, bulbuls, magpie-robins, wagtails and hoopoes.

On the other hand, man has been indirectly responsible for a diminution in the numbers of birds of prey (except the kites), bustards, florican, sand-grouse, adjutants, broadbills and most species of hornbills and woodpeckers.

Although in the past man has undoubtedly been the means of causing an increase in the numbers of many species of birds, he is to-day mainly a destructive agency. He is perhaps the greatest foe against which some species have to contend. He destroys hundreds of thousands of birds every year. Many he shoots for sport, food or medicine, or for the sake of their plumage. He snares thousands for every bird he shoots.

Man in India is a less formidable foe to birds than he might be, because he usually confines his attention to adults.

Very few Indian boys indulge in the hobby of bird-nesting.

Cattle- and goat-herds and village boys occasionally take or destroy eggs out of mischief; but, according to my experience, they do not make a practice of so doing. The depredations effected by them are a negligible factor in the struggle for existence of birds in India. European and Anglo-Indian boys are usually

ardent bird-nesters and, as they are clever at finding nests, they take a good many clutches.

There are, however, only a few thousands of these egg-collecting boys, and their range is restricted to the vicinity of the bigger stations.

The eggs of some of the larger birds are collected and sold as food.

Most of the ducks leave India to breed, in consequence, except in Kashmir, where some of the migrant ducks nest, there does not appear to be much traffic in the eggs of wild ducks. No species nests in India in sufficient numbers to make the systematic hunting for its eggs worth while commercially. A certain number of the eggs of the resident ducks are, of course, taken. E. H. Barnes states (*B.*, VII. 287) that in two instances in which he had marked down nests of the comb duck (*Sarcidiornis melanonotus*), Brinjaris snared the adult birds and took the eggs, eleven in one nest, nine in the other. In Kashmir there used to be a regular traffic in the eggs of wild ducks, but I believe that H.H. the Maharaja of Kashmir has now made this unlawful.

The inhabitants of forest areas take numbers of eggs of jungle fowl (*Gallus ferrugineus*), but these birds are confined to the *sal* forests, and they do not breed in sufficient numbers to make it worth while for men to seek out their eggs in order to sell them. It is more profitable to keep domestic fowls.

I have never seen terns' eggs displayed for sale in India; probably the birds that breed on islets in Indian rivers are not much molested by man, because,

their eggs being tiny and the breeding colonies small, the collection of the eggs would not be commercially profitable. There appears, however, to be a regular traffic in the eggs of the larger sea-terns. Butler says (*N. and E.*, III. 298): "Writing to me from Ormarra on the 10th June this year (1878) Mr. Nash mentions that some fishermen have just arrived from Astolah with about 7000 fresh eggs of the large sea-tern (*Sterna bergii*), and that they are offering them for sale as food at the rate of 60 for a rupee."

H. Whistler states that in the Punjab the hillmen take great quantities of chukors' (*Caccabis chucar*) eggs for food. The hillmen are particularly destructive to birds' eggs. H. Stevens states: "The hill boy of Sikkim spares nothing in the egg and bird line that comes his way."

R. M. Betham says (*B.*, XIII. 658) that boys habitually plunder the eggs of the black-naped blackbird (*Merula nigripileus*).

Even eggs as small as those of the larger bee-eaters are taken and eaten by Indian coolies. J. Davidson, writing from Kanara, Bombay, says (*B.*, VII. 333): "The Public Works coolies employed on the roads have an abominable habit of digging out and eating the birds and eggs of the blue-tailed bee-eaters (*Merops philippinus*)." And "E.C.J.B." says (*B.*, XVII. 965) that in the Khasia Hills few clutches of the blue-bearded bee-eater (*Nyctiornis athertoni*) ever get hatched, the Khasias digging them out to eat.

Those who feed on eggs of this class eat incubated eggs as readily as they do fresh ones!

The Nicobaris eat the eggs of the megapode (*Megapodius nicobariensis*), which they abstract from the mounds, taking care when so doing not to destroy the latter. Hume records (*N. and E.*, III. 541) that he was shown a mound from which during the previous month some twenty eggs had been taken.

Many of the nests of the edible-nest swiftlets (*Collocalia*) are taken for food. These nests are a Government monopoly on the Male Island, the right to collect them being sold by auction.

The only kinds of nestling which are habitually taken by professional bird-catchers in India are, I believe, those of paroquets (*Palæornis*). All species of paroquet are favourite cage-birds in India, and thousands spend their days in captivity. Every spring numbers of bird-catchers search systematically for the nests of paroquets and take every nestling they can find. These are sold in the bazaar for about four annas (fourpence) apiece. R. C. H. Moss-King reports (*B.*, XXII. 98) that in the Saugor District contractors regularly pay for the right to take all the young parrots in particular tracts of the jungle. Thus a large percentage of paroquet nestlings find their way into captivity.

As has been remarked, the average professional bird-catcher confines his attention almost exclusively to adult birds.

The great bulk of those captured are sold as food. Many are taken for sale as cage birds. A certain number are required as medicine. A few species are caught to be kept as fighting birds. One or two are taught tricks, such as firing a miniature cannon,

and carried round the country for exhibition as performing birds. Lastly, there are the birds of prey caught to be trained as falcons. Falconry is a popular sport in many parts of India, particularly the Punjab.

Now that the export of plumage has been prohibited by the Government of India the number of birds killed for their skins, although probably considerable, is far smaller than it used to be.

P. T. L. Dodsworth states (*B.*, XX. 1108) that before the Government prohibited the export of plumage the total quantity of feathers exported from India during the years 1895–1910, as shown by the Customs declarations, amounted to 1,149,345 pounds weight and was valued at Rs1,550,831 or over £100,000. Taking on an average thirty skins as weighing one pound, the export would be about one million skins a year. The figure was undoubtedly higher, as, according to Dodsworth nearly five hundred thousand birds were destroyed for their skins in the Lucknow and Amritsar Districts alone.

Owls and all kinds of bright-hued birds used to be killed for their plumage. Black partridge skins were exported in very large numbers. Dodsworth states that it was reported from Bombay that a single railway station to the north of Sind exported within a few months 30,000 skins of this species.

The birds commonly caged in India are about ten species of paroquet, particularly: Large Indian Paroquet (*Palæornis nepalensis*), Rose-ringed Paroquet (*P. torquatus*), Western Blossom-headed Paroquet

(*P. cyanocephalus*), Eastern Blossom-headed Paroquet (*P. rosa*), and the following:

Grackle—*Eulabes intermedia.*
Shama—*Cittocincla macrura.*
Red Munia—*Sporæginthus amandava.*
Green Munia—*Stictospiza formosa.*
Crested Lark—*Galerita cristata.*
Red-billed Blue Magpie—*Urocissa occipitalis.*
Black-headed Jay—*Garrulax lanceolatus.*
White-crested Laughing-Thrush—*Garrulax leucolophus.*
Liothrix, or Pekin Robin—*Liothrix luteus.*
Racket-tailed Drongo—*Dissemurus paradiseus.*
Spotted Munia—*Uroloncha punctulata.*
Sharp-tailed Munia—*U. acuticauda.*
Koel—*Eudymanis honorata.*

Of the above the only species caught in sufficient quantity to exercise an appreciable effect on their numbers are the paroquets, grackle, shama, red and green munias and the crested lark.

Various species of quail, partridges and bulbuls are caught and kept as fighting birds. No sight is commoner in India than that of an Indian walking along the road holding a little wicker cage, followed by the inmate—a grey partridge (*Francolinus pondicerianus*)—as a dog follows its master. In Oudh red munias (*Sporæginthus amandava*) are kept as fighting birds, heavy bets being made on the contests.

The goshawk, shikra and all species of falcons, particularly the peregrine, are caught and trained to

hawk, but, as these trained birds are usually liberated at the end of the cold weather, the practice of falconry has little or no effect on the raptorial population of the country.

A goodly number of birds are caught in India to be taken as medicine. My knowledge of the indigenous systems of medicine is very limited, in consequence I am not able to say to what extent the various species of birds are killed for use as medicine. So far as I am aware only birds of striking colouring or shape are believed to possess medicinal properties. Some idea of the Indian beliefs may be gathered from the following incident. A few years ago my friend, Hakim Sayad Hussain, a well-known physician at Ghazipur, informed me that he had read with great interest an essay of mine on the Indian hoopoe (*Upupa indica*), but complained that I had failed to mention the most important quality of the bird, namely, its medicinal value. I professed penitence, said that I was not aware that the hoopoe possessed such qualities and that I should take it as a favour if he would let me know the diseases for which Mohammedan doctors considered the flesh of the bird to be a specific. Two days later the hakim presented me with a document which ran: "The flesh of the hoopoe is a purgative and cures colic and dysentery and is useful in Bright's disease. Its heart roasted in ghee (clarified butter) and mixed with honey strengthens the memory. Its heart, if eaten dried, cures impotence, and extract of its gall bladder dropped into the eye cures many diseases of the eye. If a hoopoe be killed and hung on to a door,

it takes away witchery and cures apoplexy. It is not in any way poisonous." Seeing how many are the medicinal qualities deemed by Mohammedan doctors to be stored within the hoopoe, it is surprising that it has not become extinct.

"Raoul" writes (*Indian Game Birds and Some of Their Habitat*): "Among Hindus brahminy ducks are allowable as food to the highest castes, and are also prized for their medicinal properties. The dried and powdered gizzard . . . is considered as a panacea against all disorders of the liver and spleen."

E. C. Stuart Baker states (*B.*, X. 566) that in Assam the wreathed hornbill (*Rhytidoceros undulatus*) is deemed to be a cure for impotence. He adds: "Near Sylhet certain trees are regularly leased as preserves for this bird, which is in great request as food for ladies who wish for large families. I have seen a dozen birds procured in a day from such a preserve."

The flesh of the crow-pheasant (*Centropus sinensis*) is considered by many Indians to be a cure for consumption, and, as this bird is accounted a delicacy by some low-caste people, it often falls a victim to man.

C. M. Inglis states (*B.*, XIV. 766) that the legs of the demoiselle crane (*Anthropoides virgo*) are sold for medicine at one anna each.

The keeping of red munias (*Sporæginthus amandava*) is believed to ward off epidemics.

The numbers of birds killed or captured for the above purposes, although large, pale into insignificance

before those which represent the birds caught or killed for food.

The Indian is very catholic in his taste as regards birds. The following are habitually eaten as food: all species of ducks and geese, all game birds, peafowl, snipe, cranes, some of the starlings, all sand-pipers and plovers, coots, grebes, hornbills, larks, pipits, crow-pheasants and even crows. There are in India thousands of people who earn their living by catching birds. The devices by means of which they effect their object are innumerable and many are most ingenious. They fall into the following classes:

1. Use of bird lime.
2. Setting nooses.
3. Setting nets.
4. Setting traps.
5. Miscellaneous.

It would be wearisome to give details of the various devices with which I have seen birds caught. I have written in *Bird Notes*, May and June, 1916, an account of some of the methods in common use. Stuart Baker, in his *Game Birds of India*, cites many instances of the methods of snaring game birds. The following brief notes will indicate a few of the methods and give some idea of their variety.

Catching by Bird Lime

The great majority of small birds are caught by means of bird lime. Two or three men who make a

livelihood out of catching small birds are to be found in every district in India. The method almost universally adopted is for the bird-catcher to go forth armed with what may be described as a fishing rod without any line. This is made of bamboo joints which fit into one another. The terminal joint is well smeared with bird-lime. Taking up a position under the tree in which his prospective victim is sitting, the bird-catcher joints his rod until it is long enough to reach the victim. He then pokes the rod gingerly into the foliage and touches the bird with the sticky end. The bird adheres to this; the rod is then disjoined and the victim thus secured. This method is laborious; nevertheless, it is the one most commonly resorted to. The bird caught on the limed stick utters cries of distress: these sometimes attract its companions, and the bird-catcher captures some of them by waving his limed stick among them.

Peregrines and other falcons are often caught by means of a piece of limed cane about the length of the expanse of a falcon's wing. To the middle of this piece of cane an unfortunate dove, of which the eyes have been sown up, is tied. When the bird-catcher espies a falcon he throws into the air the dove with the limed cane attached to it. The bird flies about aimlessly and is promptly attacked by the falcon, whose wings get caught by the lime, so that it and the dove fall to the ground and the man runs up and secures his prize.

H. R. H. J. Rainey describes (*N. and E.*, III. 83) a method whereby young paroquets are caught by bird-

lime in the Sunderbunds. These birds roost in companies in reeds. Slender sticks of split bamboo, with the upper ends well smeared with lime, are placed among the reeds. During the night many of the birds get stuck to the lime. These are collected in the morning. Rainey writes: "Many are secured in this way, which is evidently profitable, for one patch of such jungle as they frequent (another may be miles away) is leased for the purpose for 20 rupees (£1 6s. 8d.) and upwards."

Catching by Nooses

Birds of prey are commonly caught by throwing into the air a white-eyed buzzard (*Butastur teesa*) having some of the wing feathers tied together (so that it can fly only laboriously) and a bundle of feathers intermingled with horsehair nooses attached to its legs. Any bird of prey in the vicinity, thinking that the feeble buzzard is bearing away booty, at once attempts robbery, and becomes caught in the nooses, so that decoy and victim fall to the ground together.

Quails, pheasants and other species are caught by being attracted to nooses by call birds. Another method is to drive birds to a line of twisted horsehair nooses. A third is to attract birds to nooses by means of bait, a fourth to place nooses in bird "runs," a fifth is to "fish" for birds with a noose hanging from the end of a light reed—the man angles from behind a bush until he succeeds in entangling the foot of his victim!

Catching by Nets

A much employed method of catching birds of prey is to set in front of a tethered decoy a net about the height of a tennis net and some two yards long. Any bird of prey in the vicinity stoops at the decoy, and, not seeing or ignoring the net, becomes entangled in it.

Quail are commonly caught on migration by placing call-birds in the evening in a field, across the end of which a net has been stretched. At dawn a rope is dragged over the top of the crop towards the net and most of the wild quail which have alighted in the field fly into the net and become entangled. Ducks are caught in a similar manner, the net being stretched across part of a lake and the birds driven to it quietly in the night time. They are put up by shouts when they have been driven near to the net, and numbers get entangled in it.

Another method of catching land birds is by driving them into an upright net arranged as a *cul-de-sac*.

Perhaps one of the most ingenious methods of driving birds into nets is that described to me by my friend M. Mushtaq Ahmad. This is used in the Punjab for partridges. A piece of white cloth, sufficiently large to conceal a man, is stretched over a bamboo frame. The bird-catcher walks carrying before him this frame, one hand being thrust through a small slit in the cloth. In this hand a partridge is held. The call of this bird attracts wild partridges, and these

walk in front of the moving frame, attracting others by their calls. They are thus made to walk into a net!

Catching by Traps

One of the commonest methods of catching birds is to arrange two parallel nets so that they lie flat in shallow water or on the ground; in the latter case they are hidden by a sprinkling of earth. They are so set that by pulling a string the outer sides of the two nets are jerked so that they meet in the air, enclosing between them any birds that, attracted by a decoy bird, have settled in the space between the nets.

The usual method of catching red munias (*Sporæginthus amandava*) is by placing some of these birds in a cage. To the base of one of the walls is a flap which works on a hinge, so that it can lie flat on the ground or up against the wall of the cage. The flap is worked by means of a string. The cage of captive amadavats is set down near a flock of wild birds. Some groundsel is placed on the flap which is allowed to lie on the ground. The bird-catcher, holding in his hand the string by which the flap is moved, hides behind a bush. When some wild birds have come to the groundsel, the flap is jerked up against the cage, so that the wild birds are caught between it and the cage. In this manner a dozen amadavats may be secured in an hour. These birds are sold at Lucknow at the rate of ten for a rupee. At Lahore the price is nine for a rupee. In Behar from twenty-five to thirty may be procured for that sum.

Quail are sometimes caught by means of decoy birds in a cage with a flap such as that just described, but in this case the flap works by means of a spring which operates when a quail perches on it.

Miss Cockburn states that a method of catching parent quail, of which the young have been captured, is to place these last in a hole about a foot deep. The old birds, finding that the young ones cannot come up to them, drop into the hole, and there find themselves in the same difficulty as the young birds, and are promptly captured.

Sand-grouse are sometimes taken by a man who approaches them under cover of a screen made of branches and drops over them a circular net attached to a hoop held out at the end of a bamboo pole.

In the drier parts of the country advantage is often taken of scarcity of water to entice birds to a trap. St. G. de Cartaret describes (*B.*, XXI. 1345) how in the Central Provinces he saw the pools in one locality guarded by branches to prevent the birds from drinking at them. Near one of them a trap, such as that described above, was arranged and sprinkled over with moist sand. The moment a bird set foot on the tempting wet sand a string was pulled and the bird became a prisoner.

Miscellaneous Methods

A few examples of methods of catching birds which do not fall into any of the above classes may be mentioned. A means of catching ducks resorting to

shallow lakes which was in vogue in the time of the Emperor Akbar, and which is still in use, is for a man to wade to the ducks with his head only out of water and concealed by being inserted into an earthen water-pot (*gharra*) having holes in its side for the man to look through. In order to get the ducks accustomed to the sight of the *gharra*, numbers are thrown into the tank at the beginning of the winter. The *gharra* into which the bird-catcher puts his head is attached to a small triangular raft made of sticks, arranged like trellis-work, having a space in the middle to admit the man's head. To this raft are attached a number of strings. The duck-catcher, having put his head through the raft into the *gharra*, sallies forth and moves very slowly to the ducks. These, being accustomed to *gharras* floating on the water, pay no attention to this one. When he is within reach of a duck the man seizes it by the feet and pulls it silently under water, where he ties it by a leg to one of the strings attached to his raft. He then lets it go. The surprised duck rises to the surface and swims about. If it discovers that a string is attached to its leg, it makes no fuss, evidently not thinking that anything serious has happened. Thus numbers of duck are secured. Then the man returns to shore, dragging his tethered birds with him. It is said that a man skilled in the work is able to catch several hundred birds in a day in this manner.

We have noticed above how jungle fowl become so engrossed when fighting that a man occasionally captures a couple of cocks so occupied by the simple

method of throwing a cloth over them. Sometimes tame partridges are taken into the fields, where their cries attract wild birds, who come and fight them. The owner of the tame bird, who is concealed behind a bush, throws a cloth over the fighting birds and so captures the wild one.

A method of catching quail, which has been described to me, but which I have never witnessed, is by means of a large bee-hive shaped basket, devoid of a bottom and having an aperture at the top sufficiently large to allow the insertion of a man's hand. In order to make use of this apparatus it is necessary to discover some bush under which quail are in the habit of congregating at night. This is done by looking during the day for their droppings. Having found such a bush, the quail-catcher visits it after dark and drops his basket over it. All that he has then to do is to insert his hand through the hole in the top of the basket and feel about until he secures the quail, one after the other.

E. C. Stuart Baker states (*B.*, XI. 403) that the Cacharies catch the eastern red-legged falcon (*Erythropus amurensis*) by shaking the bamboos in which the birds roost. As the frightened birds flutter to the ground they are seized. They are then sent to the market and sold as pigeons for two pice (one halfpenny) each!

It is not possible to estimate with any approach to accuracy the number of professional bird-catchers in India. The census returns are of very little use, for two reasons: First, many of these professional bird-

catchers are poachers and so are not anxious to disclose their calling. Such often describe themselves as cultivators. Secondly, bird-catching is a subsidiary occupation of many persons.

J. T. Martin, the Superintendent of the Census of 1921, admits (*Census of India*, I. 239) that the difficulties experienced in obtaining a trustworthy return of subsidiary occupations were serious, and that it is the general opinion of census officers that the returns of these are inaccurate. In all India, apart from dependents, over 38,000 people admitted that they earn their livelihood by hunting. Over 200,000 describe themselves as woodcutters, charcoal-burners, or firewood-, rubber-, etc., collectors. Many of these snare birds.

Over one hundred million describe their occupation as pasture or cultivation, and 3·7 per cent of these admit that they indulge in sport.

Perhaps the best idea of the number of birds eaten as food in India may be gathered from the fact that the population at the 1921 census was returned as 316,128,721 souls. Of these, rather under a hundred million are Mohammedans. Assuming that 150,000,000 of the population are vegetarians or infants, we have 160,000,000 persons who eat meat. If each of these on an average consumes six birds a year, we arrive at the figure of one thousand million as indicating the number of birds killed or caught for food every year. This figure is probably considerably below the mark. It is pure guesswork. This destruction is spread mainly over about three hundred species of birds,

some of which suffer to a much greater extent than others.

The game laws, it should be noted, apply only to the Government reserved forests, a comparatively small tract of country. These laws are habitually broken. Poaching is everywhere practised. In every district with which I have personal acquaintance the birds and mammals are literally harried, both by day and by night.

It may be remarked that, although perhaps in theory no man is entitled to shoot over land belonging to another person, in practice everyone in British India shoots, without obtaining permission, everywhere he pleases except in the Government reserved forest.

Despite all this destruction by man, there is no immediate prospect of any species of bird, except the white-winged wood-duck (*Asarcornis scutulatus*) and the pink-headed duck (*Rhodonessa caryophyllacea*), becoming extinct. The geese and the great majority of the ducks, quail, snipe and waders leave India for breeding purposes. This probably explains why their numbers do not appear to have decreased appreciably of recent years. Most of the resident ducks and game birds seem to be less abundant than they were formerly. It is obvious, however, that, unless the numbers of a species decrease very largely, no diminution can be proved by mere observation. It is only when the diminution in numbers is very marked that the field naturalist is able to detect it. In India the matter is exceptionally difficult, because hitherto very few Indians have taken up nature study; the Europeans

are only temporary sojourners in the land and few of them remain in the same locality for more than two or three years; thus there is not much of what may be described as continuity of observation.

Within the memory of man the great Indian bustard (*Eupodis edwardsi*) has disappeared from Oudh, and the lesser florican (*Sypheotis aurita*) has ceased to exist in parts of Central India, where it was once common.

C. M. Inglis records (*B.*, XXVII. 151) that the Bengal florican (*S. bengalensis*) has of recent years diminished markedly in the Jalpaiguri District of Bengal.

E. C. Stuart Baker notices (*B.*, XXVII. 198) that the black partridge (*Francolinus vulgaris*) has decreased in numbers all over its range, and P. T. L. Dodsworth records (*B.*, XX. 1107) that "over many square miles in the Rohri Division of Sind these birds had, within two seasons, been absolutely exterminated by a single party of professional trappers."

Both Horsfield's nightjar (*Caprimulgus macrurus*) and the common Indian nightjar (*C. asiaticus*) are far less abundant in Northern India than they were fifty years ago. As evidence of this I may quote G. Reid, whose notes (written half a century ago) are reproduced by W. Jesse (*Ibis*, January, 1903). Reid spoke of Horsfield's nightjar as "fairly common and a permanent resident in the vicinity of Lucknow." Jesse wrote in 1903, "I have not found the bird nearly so common as Reid appears to have done."

During the score of years I spent in India I found this bird rare or non-existent in every locality I visited,

except the forests, where it occurs in great abundance. This is a bird which cannot be overlooked; its oft-repeated and extraordinary call forces itself upon the notice of the least observant.

Whereas the diminution of numbers of the bustards, flóricans and black partridges is caused by the direct acts of man, the disappearance of the nightjars from cultivated country is due indirectly to the agency of man. The great increase of the human population of India, which has resulted from the establishment of the *pax britannica* in India, has led the augmentation of the numbers of those hangers-on of *Homo sapiens*—the house-crows (*Corvus splendens*) and brown-rats (*Mus decumanus*). These stealers of eggs and murderers of nestlings must have found the eggs of nightjars, exposed as they are on the ground, easy game, and, in consequence, the nightjars have practically disappeared from all densely populated localities.

B. DISEASE

Birds, as every aviculturalist is painfully aware, are very delicate creatures. In captivity they suffer from many diseases. Among the more common fatal ones are tuberculosis, pneumonia, septic fever, bird fever, jaundice, enteritis, plague, coccidosis, congestion of the oviduct, fits, mange, peritonitis, inflammation of the bowls, septicæmia and, among poultry and game birds, gapes.

In captivity these diseases, some of which are contagious, are often brought on by overcrowding,

improper feeding, over-feeding, want of exercise, and generally the unnatural conditions under which captive birds, particularly caged ones, live.

There is no doubt that birds in captivity are peculiarly prone to contract diseases. But it is not right to assume that all birds in the wild state are immune from disease.

It is true that sickly birds are rarely seen in nature. The reason of this is not that such do not exist, but that sickly birds live only a few hours. If not taken by some bird of prey, they are probably killed by their fellows. As H. Fox remarks (*Diseases in Captive Wild Mammals and Birds*, p. 14): "All animals hate sickness and death" and show their dislike by shunning or attacking sickly birds.

Birds in captivity may often live happily together until one becomes sick; then the others, seeing it crouched in a corner of the aviary with ruffled feathers, usually attack and kill it. Having killed it, they sometimes eat it. This used invariably to be the fate of the sickly laughing-thrushes (*Garrulax albigularis*) kept in an aviary in the Lahore Zoological Gardens.

Indian house-crows (*Corvus splendens*) in the wild state invariably destroy any member of the colony that appears to be ill. I am told of an Indian civilian, who retired many years ago and who loved not the "ignoble crow." He used to express his feelings by catching one now and again, shaving off its feathers, painting it red and then letting it go. The bird thus treated used to be set upon immediately and pecked to death by its former friends.

This habit of attacking a fellow in difficulties is said by Lockwood Kipling to be taken advantage of by the gipsy folk who eat crows. "A live crow," he writes (*Beast and Man in India*, p. 28), "is spread-eagled on his back, with forked pegs holding down his pinions. He flutters and cries, and other crows come to investigate his case, and presently attack him. With claws and beak he seizes an opponent and holds him fast. The gipsy steals from hiding and secures and pinions a second crow. These two catch two more, the four catch four more, and so on, until there are enough for dinner, or to take to town, where the crow-catcher stands before some respectable Hindu's shop and threatens to kill the bird he holds in his hand. The Hindu pays a ransom of a pice or two and the crow is released."

It should be noted that the practice of attacking a wounded bird is not universal; H. Fox writes (*loc. cit.*, p. 14): "Rarely a paroquet will stand guard over his sick and dying mate."

I have on several occasions noticed mynas (*Acridotheres tristis*) having the neck almost devoid of feathers, so that the birds had somewhat the appearance of miniature vultures. These did not seem to be molested by their companions, probably because the loss of the feathers was not accompanied by any appreciable loss of vitality.

Our knowledge of the diseases of wild birds is at present in an embryonic state. We know, however, that birds in their natural conditions are often affected by parasites, that they sometimes die of disease, that

they are liable to contract, at any rate, some of the diseases from which our domestic birds suffer, and that occasionally diseases among wild birds assume epidemic form. The following instances of wild birds in India being attacked by parasites may be cited:

H. Stevens (*B.*, XXIII. 560) once came upon two diseased Himalayan scops owls (*Otus spilocephalus*), one alive, emaciated and covered with parasites, the other dead.

At Naini Tal I found a nest of spotted forktails (*Henicurus maculatus*), in which the nestlings were "covered with tiny parasites which seemed quite ready for a change of diet, for, immediately after picking up one of the young forktails, I found some thirty or forty of these parasites crawling over my hand." (*Birds of the Indian Hills*, p. 157.)

H. N. Packard records (*B.*, XV. 139) finding some grey heron nestlings (*Ardea cinerea*) infested by vermin.

R. M. Betham states (*B.*, XV. 711) that he has seen nestlings of spoonbills, cormorants, black ibises and egrets "alive with vermin." In two nests he found dead nestlings.

J. S. Boyle records (*B.*, XVII. 543) that a sparrow-hawk (*Accipiter nisus*) he had caught died a few days afterwards. On opening the crop he found therein about twelve worms 1½ inches long of a transparent pink hue.

H. Delmé Radcliffe had (*B.*, XV. 366) three peregrine falcons (*Falco peregrinus*) killed by worms, which literally ate out their insides.

H. A. F. Magrath found (*B.*, XVIII. 290) some nests of the little Kashmir house-martin (*Chelidon kashmiriensis*) in which the nestlings were infested with lice and parasitic blood-sucking flies.

M. Young saw (*B.*, XVI. 753) fifteen or twenty dead fully fledged, or nearly fully fledged, nestlings of *Hirundo fluvicola* in a colony of eighty or one hundred nests near Mhow.

There is abundant evidence that wild birds are sometimes attacked by parasites which prey upon domestic birds.

In the Lahore Zoological Gardens we used to rear peafowl by hatching the eggs under domestic fowls. During the rainy season all the pea-chicks used to die unless they were examined daily and the ticks removed which had established themselves under their wings.

There is a record (*Indian Museum Notes*, Vol. IV, No. 2) that a number of domestic fowls were killed by ticks at Bandra.

M. Bedford writes (*A.M.*, May, 1911, p. 212): "Sixteen Darwin's rheas were hatched, but only four were reared. Both adults and young birds suffered very much from ticks, which attached themselves round the eyes. After the ticks came flies, which caused the eyelids to swell so that the birds were blinded and could not feed."

The disease known as "gapes" (because its chief symptom is a gasping for breath), which affects domestic fowls and almost every kind of bird in captivity, and which is due to a nematode (round-

worm) called *Syngamus trachealis*, is known to affect many kinds of wild birds.

A. F. Mogy records (*A.M.*, April, 1918, p. 195) finding gapeworms in the windpipes of jackdaws and nutcrackers. Others have discovered these parasites in wild duck, peafowl, pheasants, rooks and thrushes.

H. Fox (*Diseases of Captive Wild Mammals and Birds*, p. 3) writes: "Several years ago there were received from the Island of Chincoteague, off the coast of Virginia, a number of native birds recently captured, all of which had mould disease of the air sacs. This happened on several occasions, so that it became necessary to reject all birds from this locality. Among the birds were meadow-larks and cardinals."

There are other instances of epidemics among birds. These epidemics occur most commonly among gregarious species. Two conditions seem to be favourable to such epidemics. Darwin (*Origin of Species*, 6th Edition, p. 55) mentions one of them: "When a species," he writes, "owing to highly favourable circumstances increases inordinately in numbers in a small tract, epidemics—at least, this seems generally to occur with our game animals—often ensue." In India an epidemic among birds is likely to follow in the train of a drought, as the result of which the half-starved birds of a locality are weak and emaciated. Germs and parasites abound and are probably to be found in most wild birds. Under normal conditions the birds in which they take up their abode are able to overcome them. It is when the hosts are below

par or the germs or parasites become unusually abundant that trouble to the birds ensues.

In 1907 a number of wood-pigeons in England died of diphtheria. E. B. Ticehurst discovered (*British Birds*, January, 1908) that this disease was caused by *Bacillus diphtheriæ barum.*

The only instance of an epidemic among birds in India of which I can find mention is that recorded of the sparrow (*Passer domesticus*) by D. D. Cunningham on page 195 of *Some Indian Friends and Acquaintances:* "Like so many other gregarious animals in India, sparrows seem to be occasionally subject to destructive epidemics, causing a large, though temporary, reduction in their numbers. The town and suburbs of Calcutta are usually peopled by throngs of sparrows; but in the year 1895–1896 they fell away greatly in numbers, and were, for a time, so rare that, even when carefully looked for, it was only at wide intervals that one or two were to be met with during the course of long walks and drives through their favourite haunts. Before I left the locality in the spring of 1897, a perceptible increase had taken place in their numbers." That there are not more records of such epidemics in India is almost certainly due to lack of observation. The birds that die disappear so quickly that the mortality is not noticed unless especially looked for.

P. T. L. Dodsworth records how he accidentally discovered the existence of an epidemic among flying squirrels (*Pelaurita fulvinus*) at Simla. "A colony of these squirrels," he writes (*B.*, XXII. 741) "inhabited

the loft of my bungalow in Simla for various years. During the summer of 1911 I noticed that they began to die off, one after another, without any apparent cause. This led me to examine some other haunts of this species which I had previously discovered at different parts of the station and where, to my surprise, I discovered a similar high rate of mortality. In the neighbouring jungles some more dead bodies of these squirrels were discovered. All the squirrels which had died belonged to one species (*S. fulvinus*); the other species of flying squirrel which abounds here did not seem to be affected in any way: and only the very old individuals of *S. fulvinus* appeared to have succumbed to the disease. It was curious that not a single dead young or immature one was found anywhere, though a special search was made for them."

Here, then, was an epidemic affecting one of the common animals of Simla which was discovered, as it were, by accident. Had a colony of the species affected not been inhabiting Dodsworth's house, the existence of the epidemic would never have been known.

We know that millions of rats in India die of plague. We also know that wild elephants in Burma sometimes succumb to anthrax.

These instances are, so to speak, forced upon our notice. The rats die in houses in numbers, so must be seen, and the elephant is so large an animal that the bones of a dead one remain lying visible for years.

It is not possible in the present state of our knowledge to measure the power of disease as a check on

the growth of the avian population. It probably prevents any undue increase of any species of bird in any one locality. It must often hasten the end of old birds by rendering them so weak that they fall easy victims to birds and beasts of prey.

As many of the nests of birds which lay eggs in holes are very insanitary, it is not improbable that such species suffer from disease to a greater extent than those which build open nests. This may be one of the reasons why birds which nest in holes, where their eggs and young are comparatively immune from the attentions of birds and beasts of prey, are not more abundant than they are.

C. ACCIDENTS

Birds, not infrequently, suffer what a coroner's jury call "Accidental death."

We have seen that the eggs and young of doves and other species which build nests in dangerous sites are often destroyed by falling out of the nest. At Lahore four myna nestlings (*Acridotheres tristis*) fell out of a nest in a bougainvillea creeper and were drowned in a tank below. The young of wading birds occasionally get stuck in mud from which they are unable to extricate themselves. F. E. Blaauw records (*A.M.*, November, 1908, p. 38) losing a young white-necked crane, which, when about two feet high, stuck fast in the mud of a pond; in its struggles to extricate itself it broke both wings. It died two days later.

M. Bedford states (*A.M.*, May, 1911, p. 214) that a young sarus crane (*Grus antigone*) in his aviary lost its life by wading into soft mud, in which it stuck.

R. Foulkes records (*B.*, XV. 727) how he once rescued a drowning edible-nest swiftlet.

Many birds are killed by dashing against telegraph and telephone wires. Birds often meet with accidents during migration. Thousands are killed annually by flying against lighthouses at night. Many lose their way in the course of the long migratory flight. Numbers are drowned: these, while flying over the sea, become too exhausted to continue the journey. E. C. Stuart Baker records (*B.*, XXIX. 584) that one morning in October at least two hundred grey quail (*Coturnix communis*) fell on to the ship in which he was sailing, they "just dropped on to the deck so exhausted that they allowed themselves to be picked up."

Birds occasionally meet their death in strange ways. C. G. Rogers saw (*B.*, XXI. 294) a fully fledged white-collared kingfisher (*Sauropatis chloris*) crying out and lying helpless, its feathers and wings hopelessly stuck together by the gluey seeds of *Pisonia excelsa*.

B. B. Osmaston, while bird-nesting near Dehra Dun (*B.*, XXIV. 822), disturbed a scops owl (*Scops bakkamœna*) that was sitting in a small tree over which the prickly climber, *Cæsalpina sepiaria*, was spreading. The owl, in its flight, accidentally collided with one of the spiny branches of the climber and was caught by the eyelids by "at least two thorns both above and below the eye and so securely" that Osmaston thinks

it improbable that the bird would have managed to effect its escape unaided.

J. Manners Smith saw (*B.*, XVI. 755) a young magpie-robin (*Copsychus saularis*) killed by a swallow, which swooped at it and struck it a severe blow on the head.

Accidents to wild birds, although not uncommon, are not, except perhaps in the case of migrating birds, sufficiently frequent to operate as an appreciable check on the avian population.

D. FORCES OF NATURE

(1) Excessive Rainfall and Floods

When discussing the effect of food supply on the avian population, we noticed how the amount of food depends on the quality of the monsoon. A good rainfall results in abundance of food, which leads to an increase in the bird population.

On the other hand, excessive rainfall is the cause of considerable mortality among nestlings. While rain is pouring in torrents it is almost impossible for the parents to feed their young. If the nest is an open one, one of the parents has to brood the nestlings to protect them from the rain.

H. A. F. Magrath writes (*B.*, XVII. 293) of the little Kashmir house martin (*Chelidon kashmiriensis*): "On cold rainy days the young often have to go foodless for hours. One wet day I remember they were not fed from early morning till past 1 p.m.

Ordinarily the nests were visited by the parents with food on an average every four or five minutes."

The fast enforced by heavy rain leaves the young ravenous, and when feeding operations are resumed the weaker nestlings have to wait until the cravings of the stronger are satisfied; this is likely to result in the death from starvation of at least one of the weaker.

H. A. F. Magrath says (*B.*, XIX. 152): "The very heavy and almost incessant monsoon of the present season (1908) in the Punjab Himalayas probably frustrated all attempts at nesting on the part of the luckless Himalayan greenfinch (*Hypacanthis spinoides*). . . . Captain Skinner found one or two washed-out nests at Dungagali."

The same observer writes (*B.*, XIX. 755): "Frequent and severe storms throughout May and June interfered to some extent with the breeding season of 1909 in the Galis, and genera, such as the sibias, drongos, minivets, cuckoo-shrikes, grosbeaks and others which nest in open and exposed situations suffered considerably."

A. E. Jones records (*B.*, XXIII. 580) how he came upon the nest of a pair of hobbies (*Falco subbuteo*) containing three young ones from sixteen to eighteen days old. He took one of them from the nest, leaving two. Eight inches of rain fell shortly after he had visited the nest. When later he returned he found both nestlings dead; one of them had been partly eaten up. The want of food and cold caused by the rain had resulted in the death of these youngsters

and the parents were undoubtedly making the best of a bad job by eating them.

Heavy rain causes the destruction of a great many nests either before or after completion. In the Himalayas it is not an uncommon thing for the clay nests of Hodgson's striated swallow (*Hirundo nepalensis*) to fall to the ground by their own weight owing to the amount of moisture they absorb from the saturated atmosphere.

E. H. Gill records (*B.*, XXIX. 108) the destruction of the nest of a pair of ioras (*Ægithina tiphia*) by heavy rain that fell in August.

F. R. Blewitt likewise mentions (*N. and E.*, I. 153) the destruction of a nest of the same species by heavy rain early in September.

A. Anderson records (*N. and E.*, I. 143) that great numbers of the nests of the white-eye (*Zosterops palpebrosa*) are washed down in a half-finished state by heavy rain.

Birds which excavate their own nests in trees are usually careful to make the aperture in such a position as to prevent the nest being flooded by heavy rain. Those that have to utilize ready-made cavities are not always able to ensure this, so that their nests are sometimes flooded.

C. M. Inglis records (*B.*, XIV. 585) that a nest of the mottled wood owl (*Syrnium ocellatum*) was swamped by rain and deserted.

In years of heavy rain large numbers of nests on the ground are flooded and the eggs destroyed or the young drowned.

The following appeared on page 631 of the volume of the I.P.M. for 1924: "After all the rain India has been blessed with this year, the jungles are exceptionally thick and driving them properly is about as easy as trying to walk a greasy pole in your shoes. A correspondent with an extensive experience of hill shooting makes one interesting comment: of ten pheasants actually brought to bag, all have been cocks, and all of them either last year's birds or older. In several drives he has seen only two hens flushed. It is rather curious that no young birds should have been bagged. Of course, with the jungle as thick as it is, a lot of birds never moved at all, but, even so, it is a remarkable coincidence that no young birds have been put up."

The reason why no young birds were seen was doubtless the fact that the heavy rains destroyed most of the eggs and young.

Lowther, writing from Sahibganj on November 3rd, 1919, says: "The water-birds down here have had their nests drowned out quite twice, and I have consequently found eggs up to a very late date."

R. M. Betham records how the nest of a desert lark (*Alæmon desertorum*) became buried as the result of heavy rain. The nest in question was on a hummock of coarse grass: the heavy rain caused water to pour over it, carrying sand in which the nest eventually became buried. He states that the owners of the nest made another near by, twelve inches above ground level, in the fork of a small tamarisk.

C. M. Inglis states (*B.*, XII. 774) that he came upon

a lake in which whiskered terns (*Hydrochelidon hybrida*) were nesting. It was late in the season and the eggs he found were much incubated. In the following year, earlier in the season, he sent a man to the lake to look for nests. The man saw five nests in which eggs had not yet been laid. On a second visit, ten days later, he found that the terns had all left the lake. Inglis thinks that the excessive rain that fell between the two visits may have caused the terns to desert their nests.

W. H. St. Quinton records (*A.M.*, December, 1911) that a little bustard in his aviary in England was washed off her nest by an exceptionally severe storm, her eggs became chilled and the chicks perished in their shells.

Another effect of heavy rain is to put a stop to the nesting operations of those birds that breed in the hot, dry weather. The majority of these have reared their broods by the time the monsoon rains begin, but those having late broods owing to the destruction of the earlier ones, are liable to be overtaken by the monsoon. In such cases the rain, so to speak, puts the finishing touches to the destruction begun by predacious creatures.

Excessive rain indirectly causes much damage to nests by swelling the rivers and streams to such an extent that they overflow their banks and cover the surrounding country. All ground nests on the land so flooded are, of course, destroyed.

Floods in India are either periodic or irregular. The periodic floods are caused by the melting of the

Himalayan snows, and affect only the river beds; the irregular ones are caused by excessive rainfall.

In order that those who have not visited India may appreciate the effect of the periodic floods on bird life, it may be stated that the bed of a typical Indian river, such as the Ganges, the Jumna or the Ravi, is anything from half a mile to five miles broad, according to the nature of the country traversed. In most reaches the banks are not high. When swollen by the combined melting of the Himalayan snows and the monsoon rain, the rivers are mighty streams filling the whole of the ample bed, and, if the rainfall be unusually heavy, flooding the country on either side. The extent of the flooding, of course, varies with the quantity of the rain. In 1856, owing to heavy rainfall in September, the Ganges at Mirzapur rose fifty feet above the ordinary level, and in Lower Bengal that river was transformed into a lake about four hundred miles long, and, in several places, more than one hundred miles broad.

As soon as the rain stops the rivers begin to contract, they cease to fill the whole of the bed, and sandy islets appear in the stream. These islets increase in size as the water-level falls during the cold and the early part of the hot weather. By Christmas the river bed has become a sandy waste, through which an insignificant stream meanders. On these islets, thousand of terns, skimmers, pratincoles and other birds nest.

When the Himalayan snows melt in April under the influence of the sun, the rivers of Northern India rise, and this gradual rise results, sooner or later, in

all the islets on which the birds lay their eggs becoming submerged. The submergence of an islet, of course, means the destruction of every egg and nestling on it. Most of the birds have reared their broods before the islet on which they nest becomes flooded. But large numbers of eggs and nestlings are destroyed by crows and other predatory creatures; the birds which have been thus despoiled lay a second clutch, or even a third one. It is these later clutches and broods that suffer from the rising of the rivers.

The waters rise much earlier in some years than in others, and so the destruction owing to this cause is greater in some seasons than in others.

This rising of the waters renders it necessary for all the birds that breed on the river islets to lay early. The reason why the gull-billed tern (*Sterna anglica*), which is so abundant, leaves India to breed seems to be that it lays later than do the other species of tern, so that, if it nested on these islets, its broods would be destroyed by the rising waters.

Occasionally a river rises suddenly in April, owing to unseasonable rain. When this happens there is great loss of terns' eggs and young.

H. Whistler, writing on April 10th, 1914, of the river Jhelum, in the Jhelum District, says (*B.N.*, June, 1914, p. 202): "Spent the day on the river, which was greatly swollen, though the recent floods had subsided, leaving, however, their mark in the shape of changes in the colonies and sandbanks; all the nesting colonies of terns and pratincoles have been washed away, and most of the birds appear to have departed

temporarily in disgust." On that occasion the rise of the river was caused by a high east wind and rain on April 6th.

Ground-laying birds that nest near tidal rivers lose many eggs and young owing to exceptionally high tides. H. Wenden records (*N. and E.*, III. 357) an unusually high tide at Kalyan, near Bombay, one September, that swamped the nests of the bronze-winged jaçanas (*Metopidius indicus*). These birds laid second clutches; Wenden states that these consisted of but four eggs instead of the usual eight or ten.

Birds that lay on the ground are not the only ones which suffer from the rising of the Indian rivers. C. M. Inglis states (*B.*, XIII. 630) that in 1899 many nests of the bank myna (*Acridotheres ginginianus*) in the banks of the Kamla river in the Dharbhanga District were washed away by the rising waters. He records the destruction from this cause of sixteen nests in April and three in June.

Birds, of which the nests are liable to be affected by floods, have to vary their nesting season with the locality if they are to rear young. It is in such circumstances that natural selection becomes operative—birds that nest at the wrong time fail to rear young, and such must change their habits or become extinct.

K. C. Macdonald cites an interesting example of this phenomenon (*B.*, XVII. 503) in the Myingyan District, Burma. The eggs of the spot-billed duck (*Anas poecilorhyncha*), he writes, "have been brought to me in October, and I came upon a brood of

ducklings only a few days old at Panyo on the 13th December, 1902. This appears very late. I am inclined to think that all the water birds have to breed late here owing to the fact that the height of the water in their breeding haunts is quite unsettled because of rises and falls in the river until October. About the end of September the water begins to fall in earnest; and only then would it be safe for those birds that nest on the ground or in the shrubs in the *jheels* (lakes) to commence building. In September I found a clutch of fourteen eggs of the present species deserted because the sudden rise had inundated the nest. The eggs were fairly fresh."

E. C. Stuart Baker (*B.*, X. 543, 562) cites other examples: In North Cachar, where the white-breasted kingfisher (*Halcyon smyrnensis*) breeds in holes in the banks of big streams, their nests are liable to be flooded after the end of April; accordingly the birds there lay between March 25th and April 10th. On one day alone Baker found no fewer than twenty nests with eggs of this species.

For the same reason the chestnut-headed bee-eater (*Melitophagus quinticolor*) breeds in April; even so, "an unusually early rainy season destroys countless eggs and young, and the whole labour of excavating, incubating and rearing of the young has once more to be undertaken, so that, in such a season, the eggs may be found until a very late date. Thus in 1892 the heavy floods of March and April destroyed all the river nests and the birds were driven to breed inland. I found them breeding in May and early June, taking

their eggs . . . as late as the 28th June. On the 14th of that month I shot some birds of the year which were hawking insects with many other adult birds."

H. Stevens points out (*B.*, XXX. 67) that the white-tailed bush-chats (*Saxicola leucura*), which dwell in the plains in the vicinity of Sikkim, breed "much earlier than was suspected, before their breeding grounds are submerged with the rise of the rivers and before the south-west monsoon has exercised its full force."

In dry parts of the country the common peafowl (*Pavo cristatus*) commonly lays on the ground, but in localities which are liable to floods they nest in trees. I noticed this in the case of the peafowl at Rutlam, in Central India, and Littledale, in that of those in Baroda (*N. and E.*, III. 406).

(2) Hailstorms

Hailstorms are not of very frequent occurrence in India, but when they do come they are generally severe: sometimes individual stones nearly as large as fowls' eggs fall. In Northern India, these storms usually occur in the spring when the crops are nearly ripe, and many species of bird have eggs or young. Such storms cause much damage to the crops and to the nests, eggs and young of birds, occasionally even to the adults.

Such storms are not sufficiently frequent or widespread to operate as an important check on the avian

population. But they are to be numbered among those checks which operate indiscriminately on the weak and the strong, the bold and the timid, the healthy and the sickly.

Some years ago Calcutta was visited by an exceedingly severe hailstorm, which killed very many birds. After the storm crows were seen lying dead in heaps, and, as to sparrows, A. P. Taylor writes to the *Statesman*: "In some places piles of dead bodies . . . two or three feet in depth were noticed." He remarks that the kites (*Milvus govinda*) do not appear to have suffered.

C. M. Inglis records (*B.*, XII. 680) that in 1889 he saw a whisp of snipe annihilated by a hailstorm. He adds that it was rumoured that two maunds (160 lbs.) of birds were collected on the following morning and sold in the neighbouring bazaars.

(3) Storms

The dust storms which frequently sweep over Northern India in the hot weather deal out destruction to thousands of nests, eggs and young birds. The more violent the storm the greater the destruction. It is not easy to convey to a person, who has not experienced them, the violence of such storms. In the course of some, great trees are uprooted, and, in most, huge branches are broken off. In such circumstances every nest in the trees or branches affected is destroyed. Even when branches are not actually torn away from the trees, they are often swayed and shaken

so violently that the contents of the nests therein are thrown on to the ground.

A. J. Currie (*B.*, XXIV. 573) describes how the nest of a pair of Bonelli's eagles (*Hieraëtus fasciatus*) was blown down in a storm at Lahore.

H. Whistler (*B.N.*, September, 1914) states that at Hissar the eggs of a tree-pie (*Dendrocitta rufa*) were thrown out of a nest in a dust storm. He further remarks on the number of addled eggs he came upon after a severe storm in the Punjab ; the sitting birds apparently left the nests and were carried to a distance by the violent gale, and during their absence the eggs became chilled owing to the rain that followed the dust.

The same observer records (*B.N.*, July, 1914, p. 237) the destruction at Jhelum by a dust storm in May of a nest and eggs of the wood-shrike (*Tephrodornis pondicerianus*). Further, he mentions (*B.N.*, August, 1914, p. 248) that, after a dust storm, he found many egret and heron nestlings lying dead on the ground below the nests.

I have noticed above (p. 10) the destruction of four eggs of the house-crow (*Corvus splendens*) in a storm at Lahore, also (p. 8) the discovery of a dead nearly fledged pied-crested cuckoo (*Coccystes jacobinus*) in the nest of a pair of babblers (*Crateropus canorus*) after a heavy rain storm at Lahore.

K. C. Macdonald records (*B.*, XVII. 501) that the nest of a pair of black-necked storks (*Xenorhynchus asiaticus*) was blown down by a storm in Burma.

Magrath mentions (*B.*, XVIII. 276) that a young

cuckoo in the nest of a dark grey bush-chat (*Oreicola ferrea*) came to grief in a storm in the Murree Hills.

C. M. Inglis gives an instance (*B.*, XI. 78) of a nest of the paradise flycatcher (*Terpsiphone paradisi*) being blown down by a storm before the eggs were laid.

Butler states (*N. and E.*, I. 318) that a gale arose one night and scattered all over the bough to which it was attached the nest of a pair of Indian orioles (*Oriolus kundoo*). "The birds," he writes, "at once commenced to remove it, and in a couple of days carried every particle of it to another tree almost one hundred yards off." There they built, out of the old materials, a new nest in which three eggs were laid.

Hutton records (*N. and E.*, III. 129) that a nest of a lammergeyer (*Gypaëtus barbatus*) was blown, by a gale of wind, off the rock on which it rested.

E. W. Harper states (*B.N.*, 1917, p. 161) that a kite (*Milvus govinda*) was blown into his verandah by a storm: when he saw the bird it was in such a state of exhaustion that it allowed him to capture it.

Even more destructive, though less frequent, than dust storms are cyclones. In January, 1855, Bombay was visited by a cyclone which blew down thousands of trees. After the cyclone had spent its fury, the gardens at Bombay "appeared as if a heavy roller had passed over them from the south-west: and the various directions in which the tall Palmyra trees had fallen afforded a palpable indication of the revolving character of the storm."

Nor are eggs in nests in trees and bushes the only ones that suffer as the result of storms. Many eggs

laid on the ground become so completely covered by the sand carried by the wind, that the parent birds are unable to locate them after the storm is over.

P. A. Buxton cites (*Animal Life in Deserts*, p. 111) Hartert, Rothschild and others as recording that in the Algerian Sahara, where the persistent wind is from the east, so that the sand and *débris* which it carries settle on the west side of any bush or stone, where comparative calm prevails, "several species of passerine birds regularly make their nests against the windward side of small bushes, and so avoid being smothered with sand and *débris*. They then fortify the outer side of the nest with a mass of pebbles, apparently to protect the nest from the wind."

(4) Drought

When dealing with the effect of food supply on the avian population we noticed how drought affected food supply. We further saw how it affected the breeding operations of water birds. In the case of species which nest in arid districts and which are dependent on water in small pools for drinking purposes, the failure of the monsoon may prevent many of them from rearing young.

Take sand-grouse. The adult birds require drinking-water for themselves, for which they are able to fly long distances; they also need it for their young. Their habit is to carry water to their nestlings by saturating their lower plumage with water and flying in this condition to the nest. On their arrival the

nestlings suck the water from the breast feathers and the under tail-coverts of the parents, much as a baby mammal sucks its mother's milk.

The great heat that prevails during the nesting season of the various species of sand-grouse must cause the water taken up into the plumage by bathing to evaporate very speedily, so that, if any water is to reach the nestlings, it must come from a supply at no very great distance from the nest. Now, if on account of drought, some of the desert pools become dried up before the young are able to fly, the young which obtain their water from such pools will perish from thirst. E. G. B. Meade-Waldo writes (*A.M.*, May, 1906, p. 221): "I have had the good fortune to see the males of *Pterocles arenarius*, the black-breasted sand-grouse and *Pteroclurus alchatus*, the greater pintailed sand-grouse, getting water for their young in a wild state, but, had I not seen it administered in confinement, would have considered them to be demented birds trying to dust in muddy water, when unlimited dusting ground surrounded them on every side.

"In very waterless districts, where the only water procurable was from deep wells situated at great distances from one another, this method of procuring water must be most precarious, for I saw *P. arenarius* waiting by the wells and going to the muddy spots where the skins used to be laid before being loaded on to the camels, and where the water was slopped over from the camels' troughs where the animals drank. I also saw them fly over the prickly zareba

surrounding tent-villages and go to where there was a soft spot for the same purpose."

Drought sometimes affects the breeding of birds in a most unexpected manner. A. B. Pande describes (*B.*, XXI. 676) how drought in 1911 affected the nesting of operations of weaver-birds (*Ploceus baya*). The fires which break out in unprotected forest areas are often spread to the protected forest by the burning nests of weaver-birds, which are blown about like balloons on fire. In order to prevent such fires in the protected forests in his charge, Pande arranged before the fire season of 1911 to have removed all old weavers' nests from the surrounding country. The men sent out to do this returned and reported that they could find no old nests. Owing to the monsoon having failed or being unusually late in that part of the country, the kind of grass required for the construction of these nests had not grown. A few of the birds had made unsuccessful attempts to weave nests with unsuitable material and had then departed. Pande himself visited the locality and confirmed the truth of the report; he did not see a single nest in places where in previous years he had found hundreds.

(5) Excessive Heat

The intense heat that prevails in Northern India in May and June does not ordinarily cause many of the birds to die, although some undoubtedly feel it: crows, for example, may often be seen panting with the bill agape, on account of the heat, and most birds

seek shade from noon till about 2 p.m. during the hottest part of the year.

I personally have never witnessed an adult bird in the natural state die from heat-stroke. H. Whistler, however, records that (*B.*, XXIV. 703) a young Bonelli's eagle (*Hieraëtus fasciatus*) taken by him in April to train died of heat-stroke in the Punjab on July 5th one year.

Jerdon writes (*Mammals of India*, p. 19): "Whilst on service with my regiment in the Ghazipur District in 1868, the force was encamped in a grove of trees, on one of which was a colony of *Pteropi* (flying foxes). The wind, which had hitherto been from the east and moist, suddenly changed to a fierce, hot, dry, westerly blast, and this so affected the bats that, one by one, they descended to the lower branches, being blown to leeward of course at the same time, and eventually fell to the ground, and many were picked up panting and all but lifeless, others quite dead, by our followers, Indian grooms and grass-cutters. Several birds and numerous flies also perished from the same cause."

The casualties from excessive heat occur chiefly among eggs. The temperature in the hot weather of Northern India is so high that incubating birds are able to leave the nest for hours without harm to the eggs. Some years ago I removed four eggs of the paddy bird (*Ardeola grayi*) from a nest and took them to my bungalow, where they were placed in a vase to wait until they were blown. On the third day after they were put in the vase, young birds emerged from these eggs.

Birds which lay their eggs in the open on the bare ground have, however, to sit closely during the day to prevent their eggs being baked by the sun's rays. Numbers of eggs of sand-grouse, terns and the like become addled owing to exposure to the sun. Cock (*N. and E.*, III. 362) records that near Nowshera he frequently found the eggs of the common sand-grouse (*Pterocles exustus*) with the albumen semi-coagulated by the heat. "I fancy," he writes, "if the bird left its eggs for any time during the heat of the day they would be baked!"

C. B. Ticehurst records that in India the eggs of gulls, pratincoles and the Caspian tern (*Sterna caspia*) are often killed by exposure to the hot sun. Birds which lay their eggs on the bare glittering sand resort to numerous devices to prevent these being baked by the sun.

P. A. Buxton writes (*Animal Life in Deserts*, p. 106): "The devices to which the parent birds resort to avoid such fatalities are extremely interesting, because they are so varied. Many desert breeders place their nests as far as possible under shelter, most larks under a small bush, all wheatears in a hole or small cave, Hey's partridge and the seesee (*Ammoperdix*) in holes in small cliffs, or under boulders. Of the birds which breed in the open without protection from rocks or bushes, most species sit upon the nest from the time the first egg is laid. The eggs are therefore kept at a nearly constant temperature by the bird's body, and are not exposed to the heat by day and the cold by night . . . It is recorded that the pratincole (*Glareola*

pratincola) stands over its first egg, and by so doing protects it from the sun's rays, and that a small tern (*Sterna saundersi*), which breeds on the bare shore at Karachi (Sind), does the same.

"After incubation has commenced the majority of desert birds are unwilling to leave their eggs, and if they are compelled to do so they return to them as quickly as possible. This has been noticed by several observers of the courser (*Cursorius gallicus*) and sand-grouse. The eggs of the sand-grouse have additional protection from heat, for, when one parent returns from watering and relieves the other from the duty of incubation, its breast is saturated with water. Therefore it appears that the eggs and the soil on which they are laid are wetted every day, which must tend to prevent overheating."

A. J. Currie writes (*B.*, XXIV. 575) of the black-bellied tern (*Sterna melanogaster*) breeding in the bed of the river Ravi at Lahore, "during the middle of the day the birds do not appear to sit, but only to stand over their eggs to protect them from the sun, and the eggs I found at Lahore were besprinkled all over with water, apparently as an additional protection on the part of the birds to prevent them becoming overheated."

In the year 1918 at Ghazipur I noticed that all the eggs of terns that were laid late in April were placed on damp sand, presumably to prevent their being coagulated by the oven-like heat which emanated from the dry sand.

(6) Excessive Cold

I doubt whether the temperature in the plains of India is ever sufficiently low to cause the death of adult or young birds.

In the higher ranges of the Himalayas, however, the cold at the breeding season is sometimes so severe as to kill nestlings.

H. Whistler records finding on the 11th June one year some eggs of the chukor partridge (*Caccabis chucar*) that were congealed by the severe cold, snow and rain that had occurred a few days previously.

C. H. T. Whitehead writes (*B.*, XXIII. 188): "On June 26th, on top of the Balusar Pass, 13,580 feet, a blizzard-swept spot, we found a nest containing three young long-billed horned-larks (*Otocorys longirostris*) two of them were dead, evidently killed by the blizzard which had been raging for twelve hours almost on end—the parents were still busily getting food for the survivor."

VIII. SUCCESSFUL SPECIES AND VANISHING SPECIES

WE have considered the chief causes which operate as checks on the avian population of India. We have dealt generally with the whole bird population. The various checks operate unequally on the various species. Man, for example, is a powerful check on the population of spot-billed ducks (*Anas pœcilorhyncha*), but probably exercises little or no effect on the ashy drongo (*Dicrurus longicaudatus*).

The same check may act with varying degrees of intensity at various periods. Thus, in some years floods cause little mortality, while in others they destroy thousands of birds.

Before we are able to appreciate fully how natural selection operates in regard to birds, we have to know in the case of each species the causes that tend to prevent its multiplication and the extent to which each cause operates. In the present state of our knowledge we are not able to do this in respect of any single species, much less every species.

At the most we are able to say of some birds, of which the habits are tolerably well known, that their success or the reverse in the struggle for existence is

probably mainly due to certain ascertained causes. Let us consider one or two of the most successful species, that is to say, the most abundant, and some of the vanishing species.

Probably the most flourishing species of birds in India are the house-crow (*Corvus splendens*), the sparrow (*Passer domesticus*), the king-crow (*Dicrurus ater*), the common myna (*Acridotheres tristis*), the kite (*Milvus govinda*), the rose-ringed paroquet (*Palæornis torquatus*) and the little brown dove (*Turtur cambayensis*).

Let us try to set down the chief causes which have led to the success of each of these species.

The Indian house-crow is gregarious, very intelligent, omnivorous, hardy and very careful to guard its eggs and offspring.

The motto "in union there is strength" applies to birds. The crow is no match in fair fight for the larger birds of prey, not even for the kite, but what the crow lacks in strength and beak-power it makes up in intelligence, guile and clannishness. Owing to these qualities it is not very much molested by birds of prey. It is not easy to surprise a crow, and if a large bird of prey shows itself in a locality where crows are numerous these mob it and drive it away. We have noticed (p. 135) how the crows treat fishing eagles. Being omnivorous, the crow is able to pick up a living almost anywhere. Crows subsist largely on the crumbs that fall from man's table. They show little fear of man and do not hesitate to enter his habitations in order to pilfer food. I have pointed

out (*The Indian Crow: His Book*, p. 11) that the authorities of the General Hospital at Madras have found it necessary to make wire covers (like meat covers) to protect from the crows food placed at the bedside of patients. We have noticed (p. 128) the extent to which crows feed on eggs and nestlings. Crows eat fruit and grain of all kinds. They plunder the growing crops, steal grain from shops and houses and rifle it from the sacks on railway trucks. They eat termites and other insects. They pick ticks from cattle. They follow the plough for the sake of the living things exposed by it. In the rainy season they hunt for frogs. They fight with the gulls for the small fish rejected by fishermen. They share with the vultures the flesh of carcases. I have (*loc. cit.*, p. 22) described how they catch crabs at Madras. In India it is not advisable to feed one's dog out of doors, as the crows secure most of the meal; while the dog is snapping at one, others snatch morsels.

From the moment the first egg is laid until the last nestling leaves the nest one of the parent crows is always sitting on the nest or mounting guard over it.

The above are, I think, the chief reasons why the house-crow swarms all over the plains of India. It has, however, one weak point—it does not endure cold well, and for this reason it is rarely seen at altitudes more than six thousand feet above sea-level. Its cousin the corby (*Corvus macrorhynchus*) can endure cold better and largely replaces *C. splendens* in the higher mountains.

The house-crow has its enemies. Some of the larger

owls and diurnal raptores prey upon it. It is cuckolded by the koel. Man often kills it when it becomes an intolerable nuisance. The gipsies trap it for food. It has to contend for sustenance against, not only its own kind but other birds, particularly kites, vultures, sparrows and mynas. Many crows are killed by severe storms. Hence limits are set to the multiplication of even this super-bird.

The sparrow is as ubiquitous as, and even more abundant than, the house-crow. It occurs throughout the world. No country is too hot for it, and it can endure any climate, provided the cold in winter does not become severe enough to freeze the droppings of horses before these reach the ground! The sparrow is gregarious, but not quite so clannish as the crow. The stomach of the sparrow, though less accommodating than that of the crow, is capable of digesting most kinds of food. The sparrow is a parasite of man and comes into inhabited houses for food and to nest in them. The crow brings up one brood in the year, the sparrow several. The three advantages it possesses over the crow—power of resisting cold, nesting in holes and bringing up several broods in the year—more than compensates for its deficiency in some of the strong qualities of the crow. Apart from competition for food, the chief checks to the increase of sparrows are cats and other predacious creatures and occasional epidemics.

The distribution of the house-sparrow in the Himalayas and Kashmir is curiously discontinuous. The causes of this do not appear to have been investi-

gated by any observer. The bird is abundant at Kasauli, Almora, Dharmsala and Srinagar, less so at Simla and Naini Tal. It does not occur at Mussoorie or Darjeeling. Brookes stated that the bird was common at Naini Tal in 1868. This is not now the case, although a few pairs are still to be seen. In the Western Himalayas and Kashmir it has to compete with the cinnamon tree-sparrow (*P. cinnamomeus*) and in the Eastern Himalayas with the tree-sparrow (*P. montanus*). These are essentially mountain birds and their constitutions are probably better adapted to the climatic conditions of such localities than is that of the house-sparrow. It would seem that the combination of climate and competition of the hill sparrow has prevented *P. domesticus* from obtaining a foothold in the localities where it does not occur.

The king-crow must have insect food; this being so, it is unable to live all the year round in places where the cold in winter is sufficient to inhibit insect life. As its powers of flight are not such as to enable it to migrate long distances, the king-crow occurs only in warm countries. It is abundant in the N.W.F.P. and the Punjab in summer, but leaves the former province and the Western Punjab in winter, owing to the lack of insect food. Doubtless the inroads of the species into the north-west corner of the plains of India during the summer are due to the necessity of obtaining breeding areas. (See p. 55.) Nesting operations having closed, the parent birds of a migratory species probably feel a desire to return to their ordinary feeding grounds, and their young

would naturally accompany them. If, however, food in the breeding area continues to be abundant, the tendency would be for the birds to tarry, and some might not return at all, being content to enjoy the easy conditions of life throughout the year in the locality of their breeding grounds. Under such conditions a flourishing species extends its range. No such temptation presents itself to the king-crows which nest in the north-western corner of the plains of India.

In strong contrast to the abundance of the king-crow is the rarity of the white-bellied drongo (*D. cærulescens*), which has the same feeding and nesting habits. The reason of the greater success of the former in the struggle for existence is undoubtedly the courage and pugnacity of the bird. At the nesting season the king-crow is a veritable fury. It regards as its castle the tree in which it builds its nest, and attacks savagely every predacious bird and beast which comes to the tree. Other birds, such as orioles and red-winged turtle doves, often take advantage of the courage of the king-crow to nest in the same tree as it does, for the sake of the protection it affords them. The pugnacity of the king-crow, coupled with its immunity from attack by man, explains its success in the struggle for existence. The king-crow is one of the birds which man neither kills nor captures for its plumage or song or for use as food or medicine.

Several causes contribute to the success of the common myna in the struggle for existence. The myna's clannishness, pugnacity and vigour render it

comparatively free from the attacks of predacious birds. Its fearlessness of man enables it to secure some of the crumbs that fall from his table and to obtain nesting sites in and about his habitations. It nests in holes, where its eggs and young are comparatively safe. It is not killed for the sake of its plumage or for use as food or medicine. The chief checks to its multiplication appear to be competition for food and difficulty in obtaining nesting sites. (See p. 21.)

The black-headed myna (*Temenuchus pagodarum*) is no match for the common myna and has no chance against it in the competition for nesting sites. Being considerably smaller, it can squeeze through apertures which will not admit the common myna, hence it manages to thrive fairly well in places where the common species is abundant. It appears to be impatient of cold, for it is only a summer visitor to Kohat, Chitral and the Himalayas. Why it is so uncommon in the Punjab I have not been able to ascertain. I have never seen the bird at Lahore, it is rare at Amballa, but breeds at Ludhiana.

The pied myna (*Sturnopastor contra*) builds open nests in trees, so does not compete with the other mynas for nesting sites. It does not occur west of Amballa nor in South India. The reason for these limits to its distribution are not apparent. It may be a species which is only just able to hold its own and so is not able to extend its range; possibly the food on which it feeds its young can be obtained only during the rainy season, and the rainfall in the Punjab is

inadequate to produce a sufficiency of the food required, and in parts of India served by the north-east monsoon the rainfall does not occur at its breeding season.

It is not difficult to assign causes for the abundance of the kite in India. Like the crow and the sparrow it is omnivorous. It feeds largely on garbage and food thrown away by, or stolen from, man. It displays little fear of human beings. Its strongest feature is its wonderful wing power. As E. H. Aitken remarks (*Common Birds of Bombay*, p. 15): "It has no equal at that easy undulating motion, which glides down a street, tops a house, dips into a lane, rounds a corner, all with the same effortless ease." On more than one occasion I have seen a kite swoop down, seize and bear away in its talons a mutton chop which a servant was carrying from the cook-house to the bungalow. At Lahore I witnessed a kite snatch a sandwich from a table, round which some people were seated enjoying an *al fresco* lunch; the kite in its swoop not only secured a sandwich, but dashed two or three others from the plate to the ground: these were secured by crows, which attend every open-air meal.

The chief check on the multiplication of the kite seems to be fierce competition with the crows for food. Some evidence of the keenness of this competition is afforded by the fact that most of the Calcutta kites leave that city during the monsoon, because the heavy rainfall washes from the streets the garbage on which they largely subsist. At the same time, as Cunningham points out (*Some Indian Friends and Acquaintances*,

p. 21), the rain floods the low-lying areas round the town and so provides food for the kites in the shape of drowned animals. "In the summer of 1878," he writes, "an unwontedly abundant fall of rain took place in May and the beginning of June and caused an exceptionally early exodus of kites; a comparatively dry period followed, during which they returned to town."

The abundance of the rose-ringed paroquet appears to be mainly attributable to the fact that the species thrives equally well on grain or fruit. There are three crops in the year in most parts of India, and fruit trees ripen at various seasons, thus paroquets are able to obtain food in abundance at all times. C. W. Mason found (*The Food of Birds in India*, p. 188), as the result of the examination of the stomachs of this species, that, in the period December–March, fourteen individuals fed entirely on mustard and wheat, ripe and unripe; 75 per cent of the contents of the stomachs consisting of mustard; while eight individuals fed chiefly on wild figs. In May, six birds fed entirely on the pulpy part of the *lichi* fruit and six on the pulpy arils of *Cephalandra indica*. In June, three specimens fed on rice, peas and small seeds, probably of the *Sissoo*. In July, six birds were found to have fed entirely on the fruit of *Cephalandra indica*. In August and September the only food found in ten stomachs was maize. In November, one bird fed entirely on figs.

Subsidiary causes of the success of this parrot are its clannishness and the fact that it nests in holes,

either ready-made ones, or those excavated by itself. Paroquets are ever ready to mob large raptores: they fly very fast, and in consequence are comparatively immune from the attacks of birds of prey. The main checks on the parrot population appear to be limitation of food supply and the capture of young birds by professional bird-catchers. To these may be added the competition for nesting sites between them and mynas, hornbills and other birds which nest in holes.

The chief reason why the little brown dove is found in abundance throughout the plains of India appears to be the fact that it raises several broods in the year. It, so to speak, does not place all its eggs in one basket; instead of producing two clutches of five it lays four, five, or even six clutches of two. The nest is usually very exposed, and many eggs and young are destroyed, but it can well afford to lose nine clutches out of ten. It is pugnacious and, in consequence, often succeeds in driving foes from its nest. It is able to thrive equally well in damp and dry climates and so has the advantage over its near relatives, the ring- and the spotted dove (*Turtur risorius* and *T. suratensis*).

As ornithology has been studied in India for only some seventy years, and as threescore years and ten is but a brief span in the life history of a species, it is not possible to name many birds which appear to be becoming extinct. Indeed, wildfowl and game birds are the only ones regarding the abundance of which there exist any old records. By comparing old shooting records in India with those of the present day it is possible to discover in the case of most sporting

birds whether the tendency is for them to increase or diminish. Such records show that some species are diminishing in numbers. We have already noticed that, owing to the acts of man, the black partridge and the florican are less abundant in India than they were formerly. Two species of ducks seem to be in danger of extinction in India. These are the pink-headed duck and the large whistling teal.

There can be little doubt that the pink-headed duck (*Rhodonessa caryophyllacea*) is far more rare to-day than it was half a century ago, and that, unless steps are taken to preserve it, it is likely to become extinct in the near future.

Jerdon wrote in 1864 (*Birds of India*, Vol. III, p. 801): "This very lovely duck is most common in parts of Bengal, but is found at times throughout Northern India, is rare in the N.W. Provinces, and still more so in Central and Southern India. I have procured it rarely as far south as Madras, and long ago heard of its occasional visits to the Deccan, but it is only since I have visited Bengal that I have seen it in its native haunts. It shows a decided preference for tanks and *jheels* well sheltered by overhanging bushes, or abounding in dense reeds, and in such places it may be found in the cold season in flocks of twenty or so occasionally, but generally in smaller parties of from four to eight. . . . This duck is also said to occur in Burma."

In 1923 an offer of one hundred rupees (about £6 10s.) for every pink-headed duck brought sound to Calcutta did not lead to a single duck being brought

in. As the sum offered for each specimen would keep a bird-catcher and his family in comfort for five months, the fact that not a specimen was brought in gives an idea of the rarity of the species. During the period 1898–1923, the greater part of which I spent in India, I never saw the bird.

Sir J. A. Bucknall thus sums up the facts relating to the decline in numbers of the pink-headed duck (*Ibis*, 1924, p. 146): In 1878 and 1879 it was "a rare species and (except in the Purnea and Malda Districts —where it was found nesting—and a few other localities, to which it seemed to be a more or less regular visitor) hardly more than a straggler to the places from which it was recorded." In six winters A. O. Hume obtained five specimens in the Calcutta market. There are records of the bird having been shot once in 1921, twice in 1922 and three times in 1923. On one occasion several were seen together in 1923.

One of the specimens shot in 1923 was obtained in the United Provinces, and the sportsman, not knowing of the offer of one hundred rupees, ate the bird. When later he heard of the offer, he said of the duck, "though I found him good eating, it was hardly worth the money and the most expensive dish I ever ate!"

Writing of this species, Bucknall says (*loc. cit.*): "Its virtual extinction is, I imagine, due to a variety of causes: it is non-migratory and confined to India, and consequently was shot *all the year* by those to whom a close season is a dead letter. There are probably more fowling-pieces among the ryots than

there were forty years ago. Then, too, vast areas of swampy ground have been brought under cultivation within the last half century, and with more folk settled near its haunts and constantly cutting reeds and grass, its nest and eggs (no doubt excellent eating) stand little or less chance of not being discovered. I do not think it is improbable that (like the white-winged wood-duck) it moults in the autumn and for a short period completely loses its power of flight—a circumstance which would be another serious disability to its economy." To the above-named causes of the decrease in its numbers may be added the fact that it is not a diving duck; on this account it is handicapped when attacked by a bird of prey.

The brilliant plumage of the drake and the fact that it is an excellent table bird cause it to be eagerly sought after by man. Man becomes a peculiarly destructive agency to any species which, owing to its rarity, is valuable.

A vanishing species, as its range contracts, becomes increasingly liable to be affected by shortage of food due to drought. If a species is widely distributed the odds are against it being affected greatly by this calamity in every part of its range. It is otherwise with a species confined to one locality. The sudden failure of the food supply in that area may put the finishing touch to the process of extinction of the species.

The large whistling teal (*Dendrocygna fulva*) has the most extraordinary distribution of any bird in the world. It is found in India, Burma, Africa—south of

the Sahara Desert—Madagascar, Mexico, the southern parts of the United States, the Argentine, Peru and Venezuela, but not in the intervening parts of the world. The species thus affords an excellent example of what zoologists term discontinuous distribution. Its present distribution indicates that it once ranged over the greater part of the world. Discontinuous distribution is a sure sign of dwindling numbers.

As regards the distribution of the large whistling teal in India, it has been shot in most parts of the country, but, except in some localities in Eastern Bengal, it occurs nowhere abundantly.

A closely allied species—the common or lesser whistling teal (*D. javanica*) is far more common in India, although the general distribution of this last is less wide, extending, as it does, only from the Punjab to Java.

Old shooting records indicate that the large whistler used to be more abundant in India than it now is.

Thus, we have to account for (1) the rarity of the large species in India in comparison with the lesser one, and (2) the diminishing numbers of the larger species in India.

In the present state of our knowledge it is not possible to explain either of the above facts. The large whistling duck appears to have many advantages over its smaller relative. It flies and walks better, it is more wary and less easy to shoot and it has the better constitution. Finn states (*Indian Sporting Birds*, p. 59) that it is " far more hardy, bearing the English winter out of doors (where the small kind

looks thoroughly miserable and soon dies off), and even breeding."

Despite these obvious advantages the large whistling teal is not so successful in India as the smaller one. As the former is practically omnivorous, its want of success cannot be difficulty in finding suitable food, unless, of course, its young require particular food, not easily obtainable in India. At present we do not know enough of the habits of this duck to be able to say whether this is the case or not. Apart from this, the young are not at any disadvantage as compared with those of the lesser species, because both breed at the same season and the nest is in a hole in a tree, where the eggs and young are tolerably safe from the attacks of predacious quadrupeds.*

Finn suggests that the reason for the comparative failure of the large whistling teal in India may be the greater pugnacity of the smaller one. He points out that the former is afraid of the latter and "is greatly disadvantaged in India by the competition of its abundant and aggressive relative."

There can be no doubt that aggressiveness is a most valuable asset to an organism; we have noticed how this quality appears to account for the abundance of some birds in India. Where two species come into competition the more aggressive ousts the other unless this has compensating advantages.

Were the lesser whistling teal to abound in every

* The small species sometimes nests on the ground; so far as I am aware the larger one does not ever do so in India, although in South America and Africa the nest is usually near the ground. As suitable hollows in trees are scarce, a duck which must have a hole for its nest is handicapped in the struggle for existence.

tank, its aggressiveness might account for the comparative rarity of the large species. It is, however, entirely absent from many lakes which, so far as we are able to judge, appear to be well suited to it—lakes on which neither species is seen.

As in the case of other ducks, man is, of course, a destructive agency, and he is doubtless in great part responsible for the scarcity of the large whistling teal in India ; but, as he attacks both species, it does not seem possible to attribute to him the greater rarity of the large bird. This is a problem which has yet to be solved.

IX. CONCLUSION

WE have now to notice the effect on the theory of natural selection, or the survival of the fittest, of the facts set forth in the preceding chapters.

It is not possible accurately to appraise the relative potency of the various checks to the avian population, for two reasons. First, our knowledge of how each acts is at present far from perfect. Secondly, the efficacy of each check is likely to vary from time to time, also with the locality. For example, the tree-pie (*Dendrocitta rufa*), in places where it is unusually abundant, will be a more effective check on the population of small birds than in localities where it is not common; where it is not found it does not operate at all.

Speaking generally, the greatest check to the growth of the avian population is the sudden curtailment of the food supply that takes place owing to a deficient monsoon. A complete failure of the monsoon throughout India for several successive years would undoubtedly cause some species of birds to disappear from the country. This check acts only occasionally Possibly the crows, owing to their vast numbers, are, next to the failure of food supply, the greatest check

on the avian population of India. Floods afford another powerful, if only occasional, check. Man is another powerful check. As regards natural selection or the survival of the fittest, the checks to the growth of the avian population fall into four classes:

1. Those of which the operation is entirely indiscriminate or haphazard; such operate equally on the fit and unfit, the weak and the strong, birds of gay plumage and birds of sombre hue.

2. Those of which the operation is largely indiscriminate or haphazard.

3. Those which operate only on the unfit, the weak, or birds ill-adapted to their environment.

4. Those which operate mainly on the unfit, the weak, or birds ill-adapted to their environment.

It is not easy to say to which of the above classes each of the checks we have noticed falls. To the first class the following seem to belong: owls, bats, nocturnal creatures, floods, storms and accidents.

It appears to be purely a matter of chance which individuals fall victims to creatures that prey only on sleeping birds. The same seems to be true of the victims of floods, storms and accidents. A flood, which destroys every ground nest in a locality, makes no discrimination between strong and weak, fit and unfit. On the other hand, it affects mainly species which nest on the ground; in this respect it would fall into Class 2 of the checks.

To the second class the following destructive

agencies appear to belong: diurnal birds and beasts, in so far as they attack eggs and nestlings, drought, epidemics, unfavourable climatic conditions and man. These agencies are largely, but not quite, indiscriminate in their action. Thus, creatures which prey upon eggs and nestlings are sometimes frightened away by the pugnacity of the owners of a nest, or occasionally are foiled by the situation of the nest. Drought, epidemics and unfavourable climatic conditions are probably on the whole most fatal to individuals of comparatively poor physique.

It is doubtful if any of the checks which operate in India can be said to belong to the third class.

As examples of Class 4, birds of prey and other creatures which capture and devour birds, in so far as they operate by day, may be cited. Possibly the check to reproduction resulting from the inability of birds to secure breeding territory may fall into this class. There is, however, no evidence to show that it is the stronger males which secure breeding territory at the expense of the weaker. It is not unlikely that it is usually a case of "first come, first served"; the individuals which are the first to arrive secure the coveted ground, even though the later arrivals are stronger. In the case of polygamous species, however, there seems little doubt that the strongest, the most vigorous and mettlesome males secure the hens. But here again age probably plays a not unimportant part.

Thus, of the various checks we have considered, the only ones which operate entirely or mainly on the

unfit are the birds of prey and other rapacious creatures which are diurnal in their habits. The destruction caused by the other checks appears to be indiscriminate or haphazard.

From the facts that the greatest destruction is to eggs and young birds and that the forces which destroy adult birds for the most part act indiscriminately as opposed to selectively, the inference must be drawn that, speaking generally, the individuals which survive longest in the struggle for existence are the lucky ones, rather than the most fit. It is, of course, true that, other things being equal, the individuals which are fittest or strongest or best suited to their environment will have the best chance of survival. As a matter of fact other things are rarely equal. The existence of a bird may perhaps not inaptly be compared to a game of cards in which the element of chance is a very important factor. Although it is agreed that A. is the most skilled of the players taking part in the game, no one, before any particular game, would give long odds on A. winning, because far more depends on the hands dealt than on the skill of the players. So is it with birds. If we mark down, let us say, four individuals of a species, each living in an area at a distance from the others, it would not be prudent to give odds that the strongest of the four individuals will outlive the other three. The struggle for existence of birds results in the weeding out of the unlucky rather than the less fit.

In view of the evidence before us it seems difficult to accept the view held by some that all the physical

and anatomical features of every species are the result of a process whereby only the fit survive to produce young, which tend to inherit the fitness of their parents. Rather are those characteristics the result of the innate tendency of the majority of individuals of a species to vary in certain definite directions. Natural selection, the survival of the fittest, seems normally to come into action where variations markedly unfavourable to the individual appear.

Natural selection, then, seems to have played only a very subordinate part in the production of the colouring and the anatomical and physical features of the various species of birds. This, however, does not mean that it has not played its part in evolution. There are conditions in which the force comes actively into play. Natural selection, for instance, has probably helped to determine such features as the number of eggs which compose the normal clutch for each species, the number of clutches laid in the year, the time of nesting, the situation of the nest, the times of migration and the degree of pugnacity possessed by the average individual of any species.

. . . . . .

As this book is from beginning to end a recital of avian tragedies, the perusal thereof may mislead the reader into imagining that birds must be very unhappy creatures and live in constant terror of death; let me therefore state my firm belief that the life of a bird is full of happiness. It is impossible to watch birds without becoming convinced of this. It is

largely because birds are so full of joy that the observation of them affords such pleasure to men.

Of the miseries endured by mankind some, such as those which arise from the ingratitude and wickedness of others, from hopes unfulfilled, injustice at the hands of the world are not suffered by birds at all. Others, such as those caused by illness and lack of food, which are common to man and the fowls of the air, are in the case of the former greatly accentuated by the knowledge, imagination, reasoning powers and conscience of man.

Among men actual disease and sickness cause far less misery than man's knowledge of the existence of disease, the methods of its transmission and its consequences. Now, quite apart from the fact that birds in natural conditions are far more free from disease than man is, they know nothing of it and can have no fear of it. Nor can they know what death is, and so cannot dread it.

Admittedly birds display what to humans appears like terror when they hide or flee from some predacious creature. These, however, are purely instinctive acts, blind impulses followed without the actor knowing the reason for so doing. The actual sensation experienced in such circumstances is one of excitement, possibly exhilaration. A. R. Wallace said, and he may be right, that a creature fleeing from a beast of prey probably enjoys the early part of the chase, as a race-horse enjoys a race. As the pursued animal becomes exhausted its pleasure must change to feelings of discomfort and distress, possibly mingled with a

vague fear of something unknown, but when that happens the end is at hand.

Nothing is so conducive to high spirits, whether in men or birds, as the enjoyment of good health. Birds in a state of nature are nearly all in perfect health; when they do fall sick they quickly recover or die. There are many signs that birds normally bubble over with animal spirits: their song, their flights for no apparent purpose but enjoyment, and the lively way those which roost in company chatter for some time before they settle down for the night, are some of these.

From the hour when darkness falls over the earth until dawn breaks birds sleep soundly; they know nothing of sleepless nights spent in worrying over troubles, real or imaginary. Birds, being devoid of knowledge and having only very limited reasoning powers, cannot possibly "worry" any more than a new-born babe can.

Birds, lacking as they do the moral sense, are incapable of being pained by acts of ingratitude or injustice of others. For them right and wrong do not exist. A bird of prey, or a cat, when it seizes a screaming sparrow, feels no pity or remorse, it is not aware it is causing pain, because it knows not what pain is. It regards sparrows, as man regards plums, as things there to be eaten.

I do not assert that birds are incapable of feeling pain and anger. They undoubtedly do experience these sensations, but far less intensely than human beings do.

A pair of birds whose nest is destroyed or eggs stolen certainly feels something akin to human sorrow, but this, like the grief of a child caused by a broken toy, is very fleeting. Young children are generally much upset when they are parted from their mother or nurse, but in a few hours they think no more of the matter, so is it with birds. Miss Cockburn gives (p. 131) an instance of the briefness of the interval between the robbing of a nest and the resumption of cheerful song by the victims of the robbery. Jones records (p. 223) how a pair of hobbies ate up their young which had been killed in the nest by rain. The maternal affection of birds, strong though it be, is purely instinctive; as soon as the young are able to fend for themselves it vanishes completely, and, when this happens, birds will attack and drive away the young they have tended. Birds which are victimized by cuckoos pay no attention to their babes which lie dying of starvation on the ground—perhaps not two feet below the nest. We have seen (p. 83) how the wren-warbler, when victimized by the plaintive cuckoo, will turn its own young out of the nest and then work like a slave to find food for the interloper in the nest. We have also noticed (p. 81) how parent birds often allow one or more of their own young to starve in the nest.

We cannot hope to understand the ways of the feathered folk if we treat them as human beings and attribute to them the thoughts and feelings of men.

Birds are care-free beings, creatures of instinct, whose lives are full of happiness. They do not, on

the one hand, reach the heights of happiness attained by man ; on the other hand, they never plunge into the depths of misery to which human beings may sink.

The thoughts and feelings of birds differ so greatly from those of man as to render comparison impossible. They are more akin to those of children than of adult men and women. Even as the days of childhood, owing to freedom from care and the ignorance which is bliss, are happier than those of manhood, so is the life of the average bird more joyous than that of most human beings.

SPECIES OF WHICH THE NAME HAS RECENTLY BEEN CHANGED

OLD NAME	NEW NAME
Æsalon chicquera	*Falco chiquera*
Æsalon regulus	*Falco columbarius*
Æthopyga scheriæ	*Æthopyga siparaja*
Alæmon desertorum	*Alæmon alaudipes*
Alcedo ispida	*Alcedo atthis*
Amaurornis phœnicurus	*Amaurornis phœnicura*
Anthracoceros albirostris	*Anthoceros coronatus*
Anthus rufulus	*Anthus richardi rufulus*
Anthus rosaceus	*Anthus roseatus*
Anthus similis	*Anthus leucophrys*
Anthus striolatus	*Anthus richardi striolatus*
Aquila maculata	*Aquila clanga*
Aquila vindhiana	*Aquila rapax vindhiana*
Arachnechthra asiatica	*Cyrtostomus asiaticus*
Arachnechthra minima	*Cyrtostomus minimus*
Arachnechthra zeylonica	*Cyrtostomus zeylonicus*
Ardea manillensis	*Ardea purpurea manillensis*
Ardeola grayi	*Ardeola grayii*
Asarcornis scutulatus	*Asarcornis scutulata*
Astur badius	*Astur gentilis*
Athene brama	*Carine noctua*
Bubo bengalensis	*Bubo bubo bengalensis*
Buteo desertorum	*Buteo buteo*
Caccabis chucar	*Alectoris græca*

OLD NAME	NEW NAME
Cacomantis passerinus	*Cacomantis merulinus passerinus*
Casarca rutila	*Casarca ferruginea*
Cettia orientalis	*Cettia cetti*
Cheledon kashmiriensis	*Delichon urbica cashmeriensis*
Chrysococcyx maculatus	*Chalcococcyx maculatus*
Chrysococcyx xanthorhynchus	*Chalcococcyx xanthorhynchus*
Circus cineraceus	*Circus pygargus*
Cisticola cursitans	*Cisticola cisticola cursitans*
Cittocincla macrura	*Kittocincla macroura*
Coccystes coromandus	*Clamator coromandus*
Coccystes jacobinus	*Clamator jacobinus*
Columba intermedia	*Columba livia intermedia*
Coracias affinis	*Coracias benghalensis affinis*
Coracias indica	*Coracias benghalensis benghalensis* *Coracias benghalensis indica*
Corvus insolens	*Corvus splendens insolens*
Corvus macrorhynchus	*Corvus coronoides*
Coturnix communis	*Coturnix coturnix*
Coturnix erythrorhyncha	*Coryptoplectron erythrorhynchus*
Crateropus canorus	*Turdoides terricolor*
Crateropus griseus	*Turdoides griseus*
Crateropus rufescens	*Turdoides rufescens*
Crateropus somervillii	*Turdoides griseus somervillei*
Crateropus striatus	*Turdoides griseus striatus*
Cuculus saturatus	*Cuculus optatus*
Cypsellus affinis	*Micropus affinis*
Dendrocitta himalayensis	*Dendrocitta sinensis*
Dendrocitta rufe	*Dendrocitta vagabunda*
Dendrocopus auriceps	*Dryobates auriceps*

Name Recently Changed

OLD NAME	NEW NAME
Dicrurus ater	*Dicrurus macrocercus*
Dicrurus longicandatus	*Dicrurus leucophæus*
Dissura episcopus	*Dissoura episcopa*
Drymocataphus assamensis	*Drymocataphus tickelli assamensis*
Drymochares cruralis	*Heteroxenicus cruralis* *Heteroxenicus sinensis*
Erythropus amurensis	*Falco vespertinus*
Eudynamis honorata	*Edynamis scolopaceus*
Eupodotis edwardsi	*Choriotes edwardsi*
Falco barbarus	*Falco peregrinus babylonicus*
Falco chicquera	*Falco chiquera*
Falco peregrinator	*Falco peregrinus peregrinator*
Falco peregrinus	*Falco peregrinus calidus*
Francolinus vulgaris	*Francolinus francolinus*
Gallus baukiva	*Gallus gallus*
Gallus ferrugineus	*Gallus gallus*
Geocichla cyanotus	*Geocichla citrina cyanotis*
Grus antigone	*Megalornis antigone*
Gymnorhis flavicollis	*Gymnorhis xanthosterna*
Haliaëtus leucogaster	*Cuncuma leucogaster*
Haliaëtus leucoryphus	*Cuncuma leucorypha*
Harpactes erythrocephelus	*Pyrotrogon erythrocephalus*
Henicurus leschenaulti	*Enicurus leschenaulti*
Henicurus maculatus	*Enicurus maculatus*
Henicurus schistaceus	*Enicurus schistaceus*
Hierococcyx nisicolor	*Hierococcyx fugax nisicolor*
Hirundo erythropygia	*Hirundo daurica erythropygia*
Hirundo hypererythra	*Hirundo daurica hypererythra*
Hirundo javanica	*Hirundo rustica javanica*
Hirundo nepalensis	*Hirundo daurica nepalensis*
Hydrochelidon hybrida	*Chlidonias leucopareia indica*

OLD NAME	NEW NAME
Hypsipetes concolor	*Hypsipetes psaroides concolor*
Ianothocincla rufigularis	*Ianthocincla rufogularis*
Iora tiphia	*Ægithina tiphia*
Lanius erythronotus	*Lanius schach erythronotus*
Lanius lahtora	*Lanius excubitor lahtora*
Larvivora brunnea	*Larvivora cyane brunnea*
Lioptila capistrata	*Leioptila capistrata*
Lophospizias trivirgatus	*Astur trivirgatus*
Megalæma marshallorum	*Megalæma virens marshallorum*
Melittophagus quinticolor	*Melittophagus erythrocephalus*
Merops athertoni	*Nyctiornis athertoni*
Merops philippinus	*Merops superciliosus javanicus*
Merops viridis	*Merops orientalis*
Merula boulboul	*Planesticus boulboul*
Merula castanea	*Planesticus castaneus*
Merula nigripileus	*Planesticus nigropileus*
Merula unicolor	*Planesticus unicolor*
Microhierax entolmus	*Microhierax caerulescens*
Microperdix inglisi	*Microperdix manipurensis inglisi*
Milvus govinda	*Milvus migrans govinda*
Molpastes bengalensis	*Molpastes hæmorrhous bengalensis*
Motacilla maderaspatensis	*Motacilla alba maderaspatensis*
Myophoneus temmincki	*Myophoneus horsfieldi temminckii*
Nettium crecca	*Nettion crecca*
Nisaëtus fasciatus	*Hieraëtus fasciatus*
Nucifraga hemispila	*Nucifraga caryocatactes hemispila*
Oligura castaneicoronata	*Tesia castaneocoronata*
Oriolus kundoo	*Oriolus oriolus kundoo*

Name Recently Changed

OLD NAME	NEW NAME
Oriolus melanocephalus	*Oriolus luteolus*
Otocompsa emeria	*Otocompsa emeria emeria*
Otocompsa fuscicaudata	*Otocompsa emeria fuscicaudata*
Otocorys longirostris	*Otocorys alpestris longirostris*
Palæornis cyanocephalus	*Psittacula cyanocephala*
Palæornis nepalensis	*Psittacula eupatria nipalensis*
Palæornis rosa	*Psittacula cyanocephala begnalensis*
Palæornis torquatus	*Psittacula torquata*
Parus atriceps	*Parus major*
Passer cinnamomeus	*Passer rutilans cinnamomeus*
Pelargopsis gurial	*Ramphalcyon capensis gurial*
Pellorneum mandelli	*Pellorneum ruficeps mandellii*
Pica rustica	*Pica pica*
Ploceus baya	*Ploceus philippinus*
Ploceus bengalensis	*Ploceus benghalensis*
Podiceps albipennis	*Podiceps ruficollis albipennis*
Pomatorhinus maclellandi	*Pomatorhinus erythrogenys maclellandi*
Pomatorhinus phayrii	*Pomatorhinus ferruginosus phayrii*
Pratincola maura	*Saxicola torquata*
Prinia stewarti	*Prinia socialis stewarti*
Pterocles arenarius	*Pterocles orientalis*
Pterocles exustus	*Pterocles senegalensis*
Pterocles fasciatus	*Pterocles indicus*
Pteroclurus exustus	*Pterocles senegalensis*
Rhipidura albifrontata	*Rhipidura aureola*
Sarcidiornis melanonotus	*Sarcidiornis melanonota*
Sarcogrammus indicus	*Lobivanellus indicus*
Scops bakkamœna	*Otus bakkamœna*
Scops giu	*Otus scops*

OLD NAME	NEW NAME
Spizaëtus kelaarti	*Spizaëtus nipalensis kelaarti*
Spizaëtus limaetus	*Spizaëtus cirrhatus limnaëtus*
Sporæginthus amandava	*Amandava amandava*
Sterna anglica	*Sterna nilotica*
Sterna caspia	*Hydroprogne caspia*
Sterna saundersi	*Sterna albifrons saundersi*
Strix flammea	*Tyto alba*
Sypheotis aurita	*Syphiotides indica*
Sypheotis bengalensis	*Syphiotides bengalensis*
Syrnium indrani	*Strix indranee*
Syrnium ocellatum	*Strix occellata*
Thamnobia cambayensis	*Thamnobia fulicata cambayensis*
Thamnobia fulicata	*Thamnobia fulicata fulicata*
Tribura luteiventris	*Tribura luteoventris*
Trochalopterum nigrimentum	*Trochilopterum erythrocephalum nigrimentum*
Trochalopterum simile	*Trochilopterum variegatum simile*
Turdinus abbotti	*Malacocincla abbotti*
Turtur cambayensis	*Streptopelia chinensis cambayensis*
Turtur risorius	*Streptopelia decaocto*
Turtur suratensis	*Streptopelia chinensis suratensis*
Upupa indica	*Upupa epops orientalis* *Upupa epops ceylonensis* *Upupa epops longirostris*
Urocissa occipitalis	*Urocissa erythrochyncha occipitalis*
Xantholæma hæmatocephala	*Xantholæma hæmacephala*

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